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MANUFACTURING INDUSTRIES IN AMERICA

Fundamental Economic Factors

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By

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To My Parents

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PREFACE

Anyone who has been reading the books published during the past ten years about America's manufacturing industries has noticed that they fall into two main groups—they are either highly technical treatises written for specialists, or are reportorial descriptions of the picturesque features of commodity production. Obviously, books in neither of these classes fit the desires of business men or students of the economics of business. It was to help fill the gap between the two existing classes of books that the present work was undertaken.

Among men actively engaged in manufacturing there has been a growing desire to know their own business in all its aspects. Since all industries are more or less associated, an investigation of one soon leads to search into allied fields. This book is designed as an aid in such studies.

A critic of what is set forth in the following pages will discover some repetition as one industry after another is treated. This is due in part to the fact that several of the chapters appeared originally as magazine articles where, standing alone, the whole story necessarily had to be told. In the revision for the present purposes the consequent repetition was not entirely erased for the reason that many persons may not read the entire book at once, and others will not be equally interested in all the chapters; consequently, each chapter has been left complete in itself.

For permission to use again the matter that has already appeared in their pages, the author's gratitude is extended to the *Scientific Monthly,* the *Iron Age,* the *Annals of the American Academy of Political and Social Science, Education,* and the *Journal of Political Economy.*

Appreciation is due to all those associates, friends, and students, who from time to time as the material of the book was presented before them in seminar papers and class exercises, have helped to improve it by their many suggestions and comments. A special tribute is paid to Professor J. Russell Smith of Columbia University whose example has been an inspiration and whose searching, pointed criticism has often prevented regrettable error. To my friend, Professor T. W. Van Metre, likewise for similar service my debt is heavy.

MALCOLM KEIR.

Hanover, New Hampshire,
November 1, 1920.

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MANUFACTURING INDUSTRIES IN AMERICA

INTRODUCTION

Industrial Growth of the United States

There are few more interesting chapters in the history of the United States than those that record how Yankee enterprise and ingenuity won first place among the industrial nations of the world. The country possesses unrivaled natural resources which have not been permitted to lie fallow and undeveloped. Its great Mississippi Valley region has been devoted to the growth of crops and its plains to cattle-raising on a prodigious scale. Underneath the surface, coal, oil, natural gas, iron, and other minerals have been found in great abundance. On the foundation of these agricultural and extractive industries, following the precepts of Alexander Hamilton, of Tench Coxe, and Benjamin Franklin, a great superstructure of manufacturing has been reared to bring goods to the market ready for consumption.

Especially rapid has been the development of American industry in the six years since the outbreak of the war in 1914. With Europe's energies mainly devoted to destructive enterprises, the United States has been called upon to fill the void in the world's supply of capital goods. In consequence of this its foreign commerce has undergone a phenomenal growth and its industries have received a corresponding impetus.

Readjustment Inevitable

But a change is now at hand. With the world as a whole again at peace, a new commercial era has opened.

This country will be obliged more and more to meet the competition of the European nations, for they are straining every effort to restore their former productive capacity and regain the markets abandoned upon the commencement of hostilities. They will undoubtedly make inroads upon our country's foreign trade.

Consequently our country again is passing through a period of economic unsettlement and readjustment. Commodity prices are fluctuating violently and conditions generally are unstable. The times call for the exercise of extreme caution on the part of business men, as a single false step may lead to disaster. It is a period when the fundamental factors in the situation must be closely examined and followed with care.

Business a Venture

The story of the rise of the nation's great industries carries not a little of practical value to the business man, especially in the existing industrial situation. The large proportion of business failures—no less than 75 per cent of the total of new enterprises launched—is evidence that business as it is usually conducted is a highly speculative venture. There are, of course, special causes for failure in individual cases related in one way or another to poor management. Many an enterprise meets with disaster, for example, because of the inexperience of the managers, the employment of inefficient relatives and friends, or lax methods of granting credits. But apart from these errors of management there is a large element of speculation inherent in every business enterprise. Those businesses that survive and advance are the ones that are guided by a knowledge of facts and do not make executive decisions without deliberation or without exact information.

Viewing an Industry Broadly

A business man who would lay a firm foundation for continued prosperity will seek a broad general knowledge of the essential characteristics of the particular branch of industry in which he is engaged. The success of his enterprise is subject to the fundamental factors operating in the entire industry. As these factors are continually changing, he must adjust his policies to their developments. The more accurately the individual manufacturer knows the basic forces affecting his business, the better will he be able to take advantage of opportunities as they present themselves, and the larger will be the return from his enterprise.

The future of an industry frequently can be gauged by its past. The underlying tendencies at work in the present have their origin in past developments, and a study of their earlier course will disclose more definitely their present direction. For example, industries mainly dependent upon skilled labor show a tendency toward localization clearly evidenced from their infancy stage. A manufacturer engaged in one of these industries who deliberately places his plant outside of the region where most of his competitors are situated, virtually scoffs at the experienced judgment of all of his trade.

The general problem of plant location has a vital bearing on the sucess of a business concern and is one on which a study of the growth and development of the particular industry in question will shed considerable light. In deciding upon a site the manufacturer has a number of factors to take into account. He must weigh one factor against another and determine the relative amount of importance that attaches to each.

The principal considerations entering into his calculations have to do with the supply of raw material and of fuel or power, the distance to his market, the competition between railroads in determining service or rates and the influence of water transportation upon railroads, the supply and quality of labor, and the suitability of climatic conditions for his product. The ideal place for the plant exists, of course, where all these factors are found in combination. Such fortunate spots, however, are practically non-existent. Consequently advantages and disadvantages must be carefully analyzed to strike the most profitable balance.

A General Survey

Moreover in his study of underlying economic forces, the prudent manufacturer does not stop with his own industry. Some acquaintance with the more vital aspects of other important industries is an indispensable aid in selecting a wise course. The industrial world is as minutely connected as a spider's web so that a contact anywhere means a vibration everywhere and the rupture of a single strand may jeopardize the whole fabric. A corner in the American silk market recently caused a financial panic in Japan and disturbed British and French industry to the core. It is therefore well for the manufacturer to extend his survey more or less over the whole industrial field. The broader outlook enables him to observe general tendencies and to determine what relation his own industry bears to all the rest. With a broad knowledge he can make his executive decisions intelligently at all times.

The Strategic Industries

A great portion of the country's manufacturing business is represented by the larger industries, the stories of which are recited in the following pages. An intelligent diagnosis of any business situation directs attention to these principal branches of manufacture which form the central strands of the country's entire industrial web. A knowledge of the vicissitudes of these strategic industries supplies a satisfactory trade barometer and enables a discernment of the general trend of business. If, in addition, a man can see each of these important industries in historical perspective, he has the detached point of view which is essential in mapping out a future policy for his own concern. Energy, money, and time can be conserved and business be guided by judgments based on facts.

CHAPTER I

THE RESOURCES OF THE UNITED STATES AND THEIR RELATION TO OPPORTUNITY

Opportunity

National prosperity, to be enduring, must be founded upon natural wealth. Whether opportunities are rare or abundant depends upon the size of the country in which a man dwells, the number of persons competing for the use of the same area, and the richness or poverty of the resources that the region affords. Opportunity may be considered as the quotient of a fraction whose numerator is the total of the free gifts that nature provides and whose denominator is the number of people in the given locality. Judged by the interrelations between area, population, and resources, where does the United States stand among other nations?

A large country is more apt to afford a man a chance to rise than a small one, unless the major part of the large territory is too hot, too cold, too dry, or too uniform to warrant development. The extension of a land over zones unlike in climate, topography, and resource may be counted an asset because this condition assures opportunity through variety. If a nation is made up of mountain and plain, cold and hot regions, the inhabitants of each section will be engaged in different occupations, and by buying the things which they do not have, enrich each other by enlarging the operations of agriculture, mining, transportation, and manufacture. The mere size of the United States then is a factor in its favor. Florida differs from Massachusetts, southern California is unlike northern California, and Kansas City does not resemble Philadelphia; as a consequence Florida can raise oranges for Massachusetts, southern California is enabled to send lemons to the northern part of the same state, and Kansas City ships meat to Philadelphia. On the other hand, Massachusetts may sell watches, pens, pins, and machinery to Florida; northern California supply lumber to her southern sister, and Philadelphia barter carpets and stockings with Kansas City. This diversity in environment which produces variety in occupation, gives rise to a large internal domestic trade. The transportation necessary to haul products from one section to another creates so many occupations and opportunities that there are more than a million and a half people employed by our railroads alone, or an average of 6.61 persons for every mile of line. Inasmuch as the volume of freight and the multiplicity of jobs arise from the difference in resources in the various parts of our country, the United States is fortunate in being big.

Size

Although Great Britain, France, and Germany all possess internal variety, none of these nations has the extremes that are presented in the United States. To be sure, in Europe there are considerable ranges of climate from west to east because eastwardly the modifying influence of the ocean is so lessened that inland points, such as Vienna or Moscow, have a hotter summer and a colder winter than corresponding places on the coast, such as Brest or Liverpool; but no European nation covers sufficient area from west to east to experience radical climatic transitions. Since also these countries are too small from north to south to gain distinctive contrasts, their climates are more generally constant than ours. France and Germany extend north and south through about six and a half degrees, and the United Kingdom reaches ten, while the United States stretches southward for twenty-five degrees. In the opposite direction our territory covers a continent, giving us in western Kansas or northern New Mexico, for example, the most striking difference to southern California or central Maryland. As a consequence those diversities of resource that are due to modifications of weather are found more fully in the United States than in European nations. The pines of New Hampshire contrasted with the palms of Louisiana; the potatoes of Maine compared with the cotton of Georgia or lemons of California; the furs of Minnesota opposed to the hides of Texas—all are illustrations of a rule for which there are scores of other examples.

Population

Size alone, however, is not a sufficient gauge of the opportunities a region may afford, for consideration must also be given to the number of people dwelling there. A small area rich in resources, but with a scanty population, grants more chances to gain wealth than a larger domain more generously endowed whose population is proportionately larger. Thus New Zealand is a better place to live than India. Hence a statement of the area of a country, or an estimate of the tonnage of its resources, means little unless the figures of population are also known and a proportion struck between the number of men and the amount of available wealth. The highest degree of opportunity is attained in a large, wealthy country with a scanty population. Although our population is more numerous than any of the continental nations, except Russia, the overwhelmingly large area of this nation—containing a million square miles more than does (European) Russia, the second largest—with its corresponding natural wealth means that the opportunity for the individual here is great. Only our smaller states with the largest masses of people approach the density of population abroad, where from 200 to 400 per square mile is normal. New Jersey, for instance, has a density of 377, Massachusetts 418, and Rhode Island 508, whereas the average for our whole country is only 32.

In a country's early growth an increasing population does not necessarily mean a lessening of opportunity, for with greater numbers a larger subdivision of labor takes place, which in turn occasions new ways of earning a living. It is only when subdivision has reached nearly its maximum that the pressure of population upon resources begins to be felt. After this point has been attained, further increase in numbers may mean competition for jobs and the lowering of the price of labor. Then relief is sought by limitation upon population, emigration to newer lands, or stimulation of man's inventive ability. England reached this point about 1830. The larger a country is, and the more natural wealth it possesses, the longer it will take to arrive at this end. Although it is more than three hundred years since men began to draw upon the resources of our country, we have only recently begun to feel the pinch of population and that only in a few special places in the East.

Sources of Wealth

Turning from the general terms of area and population to a more specific study of our wealth for sources of opportunity, agriculture should be considered at the out-set, for wherever soil is available it is the first resource to be exploited. Man's primary needs of food, clothing, and shelter can be supplied by the soil alone. If life is sustained by mining or manufacturing, someone, somewhere, must be at work tilling the soil to produce food and raw materials. Since agriculture is fundamental, while mining and manufacturing are secondary, people who can gain a living easily from nature will not undergo the rigor of an industrial régime. As an illustration, so far as protection, natural harbors, and access to the interior are concerned, Chesapeake Bay ought to be the seat of a thriving commerce, but the natural fertility of the land around the bay has caused people to turn their backs upon the water and to develop the soil. With more than half of the total area of our country fit for farming and with the crop variety afforded by the extent of our boundaries, it is not surprising that agriculture has played an important part for so long a time in our history. Although a nation may exist by trade and commerce and may buy its food and raw materials from abroad, such a nation is subject to sudden collapse if anything destroys or interferes with its only means of livelihood; Great Britain's distress during the Great War is a case in point. Therefore a nation is fortunate that has at all times sufficient farm area to support itself. Of the entire land mass of the United States, 46 per cent is in farms, in which respect the United States stands pre-eminent among nations. We have nearly twice as many acres in crops per person as any other nation.

Crops

Of all the crops raised by the leading countries, wheat is the one which receives the greatest amount of attention. The United States stands above all others in the total amount of wheat produced, for our normal harvest is more than a third greater than that of European Russia, our nearest rival. We have so much more wheat than our own people require that in ordinary peace times we export 10 to 15 per cent of our crop to help feed other peoples whose wants are greater than their supplies, but we proved in the rigorous years 1917-1920 that under stress we can increase our production so as to feed the whole world. Although there is a closer world competition in the growing of oats, we lead in that crop also, but by a smaller margin. In barley the former Russian Empire overtopped us (33 per cent of the world's production), but we follow behind her (13 per cent of the world's output) and surpass the rest of the field in gross production; likewise in bushels per capita the United States equals the best except Algeria. So far as the other three common crops—rice, potatoes, and rye—are concerned, the tally for our country is not so favorable; but potatoes and rye are indicators of agricultural poverty, for rye grows on the poorest land while potatoes are noted for their large yield. If a nation shows farm area devoted to them it is an admission that population is pressing heavily upon resources. Rice culture is a reflection of dietary habit, climate, and cheap labor and the interrelation of these elements has caused the United States to be the smallest rice-producing country of any country where this cereal is grown at all. No European country harvests rice.

Corn

The crops so far mentioned, while common to the leading nations, are not the most important ones in the United States; even the much-vaunted wheat is of secondary importance, for, if measured by value, it ranks fourth among our farm harvests. Corn is by far our greatest agricultural resource, and not even our iron and steel manufactures can compare with it in value. An area twice the size of our wheat belt, half as large again as Italy, and nearly as extensive as the whole of France or Germany, is devoted to this cereal. Nearly three-fourths (71 per cent) of all the corn raised in the world is upon American farms. The reason why the majority of people slight the value of corn is that so much of it is consumed where it grows. Since animals on the farm eat the corn, it is not so valuable an article of freight for railroads and steamers as wheat, nor are there at shipping points great corn elevators to excite comment. International commerce is not so concerned about corn as it is about wheat, for whereas 12 per cent of our wheat crop goes abroad, only 1 per cent of the corn leaves our shores. Since foreign nations do not bid for corn for their animals nor eat it themselves, its vicissitudes do not make reading matter for newspapers and the extent to which it influences our national welfare is little appreciated.

Corn has been conspicuous in the development of America because it was so admirably adapted to a frontier, yielding a large crop in land cluttered with stumps or abounding in rocks. New land in Illinois produced 80 bushels per acre, while pioneer Ohio recorded 40 to 60 bushels. Because of its ear, corn is easily handled, and its enemies are so large that they are readily exterminated, while fewer diseases attack it than any other cereal. As for storage, corn may stand stacked in the field all winter protected by its own close-fitting shuck. If it is sown for fodder it produces more per acre than anything else known in America. In case of need it yields sugar; Connecticut settlers made molasses from corn in

1717, and today it is the source of glucose employed by confectioners, bakers, and ice cream manufacturers. On the prairies, corn oil was the means of illumination, and today it enters into commerce in the form of soap and salad dressing. As a fuel the cobs equaled good hard wood. An acre yielded 50 to 100 bushels of ears which, at the rate of 100 bushels to a cord, were valued at $10 to $15, a price that was cheaper than wood on the tree-denuded areas of the Central West. Wheat requires the best tilled lands, necessitates ten times the amount of seed as corn, takes four times as long to mature, must all be harvested at once, and is not ready for use until ground into flour. Corn is therefore the king of frontier crops. Without it the southern Jamestown and northern Massachusetts Bay colonies would have perished; corn was the crop that sustained Boone's beleaguered settlement in Kentucky; corn accompanied every advance westward and was the staff of life in each new region. Corn colonized America, and if it had not been for our food security in corn during the Great War our great democracy could not have sustained the battling European democracies by such generous supplies of wheat. So corn not only made our nation possible, but helped materially to save it from destruction in 1917.

Other Crops

Aside from wheat, which is next to corn in number of acres devoted to it, the two chief crops of the United States are hay and oats. Corn, hay, and oats are not foods for people but for animals. Our predominance in these three crops explains why we have been able to be exporters of meat for so many years. Especially significant is the relation of the corn crop to the number of swine in the United States. There were almost three times as many swine in our country as were found in pre-war Germany, our nearest rival. Both hay and corn are used to fatten cattle for market, and despite the hue and cry over the lessening resource in cattle, our country, except for India, leads in the number of heads by a wide margin. It is fortunate that our resource is so large, for our demand is relatively so much greater that even we must import meat from countries like Uruguay, Paraguay, or Argentina, whose total herds are less than half the number of ours but whose smaller population gives rise to a surplus of meat for export. The cattle industry is one illustration wherein, despite the vastness of our resource, the wants of our population have almost caught up with the supply.

Although our cattle resource is well known, many people fail to realize that our sheep-breeding is of about the same character. Eastern people, having seen or read about the relative decline in sheep-raising in America, have become imbued with the idea that we are a nonentity in this business. As a matter of gross figures, we are among the world's leaders, distancing even the United Kingdom although that country has many more sheep per square mile than we have. Some sheep are fattened on farms but our largest flocks are found on the great ranges of the Southwest and Northwest. Our great resource, however, is balanced by a great demand and a great area and so produces relative scarcity.

Cotton

Another crop which, like corn, is distinctly American, is cotton, for more than half (58 per cent) of the world crop grows in American soil. Wheat and cotton are our two agricultural exports; with the money obtained from their sale we pay our bills abroad. Since we have almost a monopoly in cotton-raising, the factories of Europe are forced to turn to us for this raw material, a fact that puts them upon a most insecure basis and has led to attempts to obtain cotton from India, Egypt, Russia, Brazil, Persia, and Peru. On the other hand, our own manufacturers are assured of a sufficient supply of raw material, for no matter what happens in the rest of the world, American cotton manufacturers need not fear a curtailment of supplies.

Despite the prevalence of cotton in our southern states, nowhere near the total land available for this crop is actually under cultivation. It is estimated that there are 700,000 square miles that might be devoted to cotton, but only one-fifteenth of this amount is tilled in reality.

The limiting factor in cotton production is not that of land but of labor, especially the labor of picking. Cotton, unlike wheat or corn, does not ripen all at once, but on the same plant, bolls may mature all the way from August to Christmas. This means that care must be taken in selecting the ripe bolls and that picking is a continuous operation extending over five months. Furthermore the cotton plant does not branch uniformly. It follows too that the introduction of machines to relieve the situation is difficult. A machine that will successfully discriminate between long and short branches or ripe and unripe cotton has yet to appear. Perhaps by plant-breeding cotton may be made to mature at one time, and also the plants may be selected for their uniformity of branching. If successful, such experiments would make picking machines a possibility. Until a satisfactory machine is found which will make such harvesting possible, cotton acreage must be limited to the number of available pickers.

Soil Fertility

In corn, wheat, and cotton the farms of the United States possess resources that place the nation on a firm basis both in regard to food and to crude stuff for our factories to manipulate. But unless new lands are constantly available, farming cannot long continue except some means is discovered of restoring to the soil those elements of plant food taken from it by successive harvests. Of all the things growing crops need, those most often lacking in the ground are potassium, nitrogen, and phosphorus. Before the Great War, Germany supplied the world with potash because she had vast deposits of rock from which this element could be easily obtained, but during the war we learned to be independent of Germany by utilizing other sources of potash. For years too Chile held the monopoly of the nitrates needed by agriculturists, but here again the need of substitutes has produced them. It is now known that certain plants have the power to extract nitrogen from the air and secrete it in their roots, and bacteriologists have shown that minute organisms have the same power. Man himself can take toll from the large supplies of nitrogen in the atmosphere, separating it by means of a powerful electric current. Our large resources in water power will enable us to generate current so cheaply that we can obtain nitrogen from the air at a low enough price to sell it as fertilizer; in fact an immense plant for this work was started during the war at Muscle Shoals, Alabama.

The third essential element for soil fertility is phosphorus; as yet no adequate substitutes have been found for phosphate rock. In this resource the United States stands almost alone. Before 1906 our farmers derived phosphate from Florida, Tennessee, and South Carolina. Between 1867 and 1913, 45,000,000 tons were taken from these three states, and it was estimated that only 58,000,000 tons remained; the only other available sources of phosphorus were in Tunis, Belgium, and France. In 1912, 3,000,000 tons were taken from our deposits, whereas Tunis produced only 1,000,000 and France and Belgium together but 500,000 tons. Hence it was a decidedly good stroke of fortune that gave to the United States, by the discovery of deposits in the West, an enormous new supply of phosphorus. The estimates of the western resource place it as immeasurably greater than all known deposits in the world, for there are about one-half a billion tons of high-grade rock in sight. As yet this rock does not influence the market because of its recent discovery, the lack of railroads, the high cost of transportation across the continent, and the remoteness of the resource from the places where it would be most used in the Atlantic coastal plain and piedmont of eastern United States. Eventually, however, with the exhaustion of our southern supply, not only the United States, but the whole agricultural world may have to draw upon our West for this most crucial element in soil fertility. In this connection it is interesting to note that the middle western farms must eventually use much more fertilizer than they do at present, because continuous use is despoiling the soils of their natural fertility. In the future a market for fertilizer will exist nearer to the newly discovered phosphorus. In consequence of recent inventions and discoveries, therefore, the United States not only is wealthy in farm lands per capita but has the means to keep the fields productive.

Forests

Since farmers' wood-lots comprise 95 per cent of the available wood supply east of the great plains, our forest resources are closely related to agriculture. In our early history, forest resources were so abundant as to be a menace, for trees occupied the ground needed for farms. Instead of being regarded as a thing of value a tree was looked upon as a nuisance to be eradicated; so forests were ruthlessly butchered to make way for plows. Later when lumbering companies began operations, the stretches of trees were so vast that no pains were taken to be frugal in the cutting, and much unnecessary waste occurred. The oldest, most thickly settled portions of the nation have seen a positive elimination of forest resources, for naturally the trees nearest to markets on easy transportation routes were cut first. As a result only 65 per cent of the original forest now remains. The careless manner in which we have used good wood for temporary articles contrasted with the painstaking economy of wood in Europe indicates how much greater than theirs our timber supply has been. But even in the United States we are beginning to put on the market cheaper woods for short-lived commodities, and to veneer high grades instead of employing solid pieces. We have not exhausted our supply, but one or two object lessons have taught us that undue prodigality does not pay.

Minerals

Cotton, wool, flax, and wood enter our industries from the farms, but mines too are an important element in the economic well-being of our nation; chief among the minerals of the world not used for power is iron. The value of iron ore deposits depends on their availability and composition. Special speedy vessels have been built for the carrying of the largest quantities of Minnesota ore across the Lakes, and iron producers along the Great Lakes waterfront can unload their raw materials directly on their own premises. Pittsburgh too is favored by the lake transportation because the longest part of the haul for her iron is by water. The eastern producers are handicapped by an overland route from the lower lake depots and so tend to import their raw materials by water from Cuba or Spain. However, we have no great advantage over Great Britain or Germany in the matter of availability of ore deposits. The English iron-producers are near the coast and can get their ore from near at hand or, like our eastern iron-makers, may import by water from abroad. Germany too can take advantage of the Rhine River for water transportation. Our chief advantage does not rest so much upon the availability of the ore deposits as it does upon their extent and composition, for our fields are not only the largest in the world but also the iron is purest. If iron ore contains phosphorus, difficulty is met in its reduction and in the maintenance of a high quality of iron; fortunately our deposits, except the southern ones in Alabama, are nearly free from this deteriorating agent. The Lake Superior ores are among the richest in the world and are so near the surface and so easy to mine that steam shovels can be employed for the work. This has an important bearing upon their value to our blast furnace operators because it makes the raw material cheap and is an offset to the labor cost, which is higher here than abroad. The United States is the greatest iron-maker in the world and her industry rests upon domestic ores. The amount of ore imported into our country is comparatively small, amounting in 1913 to about 4 per cent of that mined within our own bounds. On the other hand both England and Germany are unable to produce enough ore for their own furnaces and are forced to import large amounts.

Metals

Since copper is derived not only from copper ores, but also as a by-product from many other ores, such as lead, gold, silver, and zinc, we cannot estimate the amount of our copper resource as accurately as our iron or coal. Hence the only way we may compare our wealth in copper with the rest of the world is by figures of refiner's production. Of the copper used by the people of the whole globe, 55 per cent comes from the United States and we have no serious European rival. Spain and Portugal receive the greatest credit in continental production but even these have but one-tenth of our output. Japan competes with us, but on a par with Spain and Portugal, while Australia falls somewhat below these three. Nearer home we have the mines of Mexico and Chile with which to contend. Of all of those working with the same metal, Mexico comes closest to our yield, but whereas Mexican copper is measured by a hundred million pounds ours reaches over a billion. About half of the copper refined by the world is used for electrical apparatus, and half of the remainder forms one of the raw materials for brass. Since both of these are essential to our economic welfare, our wealth in copper is a cause for congratulation; during the Great War, Germany was vitally handicapped by her lack of copper resources.

Lead and zinc are not so important as resources or as widely useful in manufacture, as iron and copper; for instance, one-third of the lead produced is used for the manufacture of paint. Compared to the multifarious uses of iron, lead sinks into insignificance, but nevertheless it is a resource of considerable value; 32 per cent of the world's lead and 29 per cent of the zinc comes from our country. Zinc finds its largest market as a protective covering for iron that is exposed to weather, and also a large amount of it forms one of the raw materials for brass.

Since 1830 the United States has been an important source for the world's supply of silver; since 1850, of the world's supply of gold. Africa, the United States, and Australia are in a class by themselves in the production of gold, and no other part of the world's surface even remotely approaches these three leaders; Africa supplies 45 per cent, the United States 20 per cent, and Australia 11 per cent,

Coal

For manufacturing, power is often just as important an element as the possession of raw materials, and in some industries it decides where the crude stock shall be made into finished products. The principal source of all mechanical power at present is coal. All of the great nations have large coal fields; perhaps it would not be too much to add that they would not be great if they did not possess coal. Coal is the most important of all mineral products, even surpassing iron in that respect. Belgium has a place among manufacturing nations that is astonishing if her area and population only are considered, but it is easily understood if one looks at her coal resources. Much of Germany's war strategy was based on her plan to control the coal and iron fields of Belgium and France, and the peace conference controversy over the control of the Saar Valley was based on the urgent need of both France and Germany for the coal deposits located there.

Since coal is so all-important, it is very comforting for Americans to make the discovery that 60 to 70 per cent of the known coal deposits of the world are within our territory, and it is a cause for additional gratification to learn that besides being greatest in amount, our coals are of the highest known quality. Quality is determined by heating capacity—the higher the percentage of carbon in coal, the greater will be its power to throw off heat; and the harder coal is, the greater will be its proportion of carbon. The anthracite or hard coal deposits of America are by far the most important of any in the world; only in Wales is there a coal that approaches the quality of our anthracite, and even these Welsh coals are not so good as ours and would be classified here as between anthracite and soft (bituminous) coals.

Although we have the largest area of anthracite coal fields in the world, except possibly China, the actual number of square miles (496) in the anthracite fields is puny compared to our own bituminous or soft coal deposits (500,000 square miles). We are by no means so privileged in regard to bituminous as we are to anthracite, in which we have a virtual monopoly; but despite the fact that all our great sister nations own large fields of coal, none of them is of such vast extent as ours. It is estimated that we have 500,000 square miles of soft coal lands, an area that about equals the combined land mass of pre-war Germany (208,795 square miles), France (207,129 square miles), and the United Kingdom (121,316 square miles).

Petroleum

Next to coal the most important mineral power-producer is petroleum; about one-fourth of all the oil taken from the ground in the United States is used for this purpose. As the United States furnishes the greatest tonnage of coal, so with petroleum, we contribute the largest number of barrels to the world; in 1913, 65 per cent of the whole supply came from our wells. Our only serious rival in Europe is Russia; her wells on the Caspian Sea have threatened our supremacy at times, and even for a short period between 1898 and 1902 exceeded the output of the United States. Since 1902, new discoveries have constantly increased the American yield until in 1913, Russia, our nearest competitor, produced less than one-fourth as much as we did. Production in 1917 for the United States was 335,315,601 barrels, of which Oklahoma produced 107,507,471 barrels and California 93,877,549. The wells of California alone supplied over a third more than Russia. The next nation on the list is Mexico with 6 per cent. The United States has given to the world more than one-half (59 per cent) of the oil used since its discovery.

Natural Gas

Natural gas is closely associated with petroleum, but unlike petroleum it is largely used in the regions in which it is found, where it is particularly valuable to steel, glass, and cement mills. The amount consumed industrially in 1913 was worth $37,000,000, but since no other nation employs natural gas for industrial purposes we have no basis for comparison with them. The area covered by gas wells is more than twenty times as extensive as our anthracite coal fields. Wherever it can be obtained, natural gas comes the nearest to being an ideal fuel because all others must be turned to gas before they are burned efficiently, and no other gas fuel is so pure nor so rich in heat value as this one. Abundance makes natural gas cheap, while its quality causes it to be most desirable; as a result mills located in natural gas regions are doubly blessed.

Water Power

The historical rival of steam as a source of power has been the energy of falling streams. The large number of small streams in the northeastern United States enabled that section to gain an early start in manufacturing and to become the leading manufacturing region in the United States. Water power, however, is inelastic in the amount that can be applied, and its use was, therefore, restricted. This together with improvements in steam engines and the cheapening of steam power, caused a shift about 1830 to coal as the principal mainstay of industry. Of late, water power has commenced to come back into its former importance. The use of concrete for dams, the adoption of electricity, and improvements in the transmission of electricity help account for this second change. The amount of horse-power developed from water motors has about tripled each five years since 1904, and the percentage of water-developed horse-power to the total horse-power developed in the United States, although still infinitesimal (.2 per cent in 1914), has doubled in each five-year period since 1904. The increasing price of coal, added to labor and transportation troubles in connection with the use of coal, account for this growth as well as the virtues of hydro-electric power itself.

The United States is as well equipped as any country in the world to shift from coal to water power without injury and with profit. Water power in order to be economically profitable must be developed from streams with an even flow. Distribution of rainfall, slope, soil, and natural storage facilities are all factors affecting the flow. A glaciated region usually provides a large number of adequate water power sites, and, consequently, in the glaciated states from Minnesota to Maine water power has always received especial attention. Water power has been largely developed, moreover, in the mountains of the Far West, where melting snow conserves the flow.

Summary

At the beginning of this chapter it was pointed out that opportunity does not depend entirely upon resources but also upon the number of people who utilize them. If the resources decline while the population remains stationary, opportunity also diminishes. In case the population increases while resources remain stationary, again opportunity becomes less. Should the population grow at the same time that resources decrease, opportunities would vanish rapidly. It is this last condition that is facing the United States. While it is true that we are remarkably wealthy, it is also a fact that our natural wealth is being depleted at an amazing rate. Farm lands are worn out by incorrect cultivation and erosion, forests have been wasted by reckless cutting, mineral wealth has been thrown away by careless mining, while at the same time the population has been steadily increasing. Unless a halt is called upon the waste or the increase in population checked, we will no longer be the land of opportunity but our people will have to seek fortunes in new lands opened elsewhere.

Up to the year 1892 our exports were chiefly farm products. Beginning then and continuing ever since, except during the Great War, the percentage of agricultural exports to the total has rapidly declined, while at the same time and for the same period of years manufactured goods ready for consumption have comprised a larger and larger proportion of the things we have sold abroad. Today the percentage is mounting more rapidly than the increase in population; with the corresponding falling off in farm exports it follows that greater numbers of men are working in factories. Two results should follow: we ought to pay more attention to conserving the wealth we have, and our efforts to gain foreign trade ought to take a new direction. We should seek to sell manufactured goods and keep our raw materials at home. If we do, America may remain what she always has been, the place where opportunity knocks at every man's door because the resources that are the fundamentals of prosperity are abundant.

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CHAPTER II

THE DEVELOPMENT OF MANUFACTURING

Rapidity of Growth

Strikes or lockouts, frantic appeals for labor, explosions, fires, marvelous inventions, and astounding records of production—all thrust upon the attention of modern Americans the vital importance of our factories. When we travel we are amazed at the rapid construction of gigantic new mills, we are deafened by the roar of furnaces, appalled by the crash of hammers, and our passage blocked by hurrying motor trucks burdened by raw materials or piled high with finished products. Through all our senses, it is borne in upon us that we belong to a manufacturing nation.

We are more or less startled, therefore, when we come to realize that throughout all the colonial period of our history, there was little manufacturing of any kind within our borders; and we are slow to believe that until 1830 only cotton and iron manufacture had made much progress in our country, or that when the Civil War opened we had but barely removed the heavy handicaps under which manufacturing labored. Hence it is only since 1870 that we have really discovered our great resources for manufacturing and have begun to utilize them to our advantage. Manufacturing, then, is a new feature in our economic life. How it has been brought from obscurity to such prominence is the question we now face.

Hindrances to Development

In the colonial era, manufacturing was hindered by both natural and artificial barriers; in fact the difficulties were so many that it is astonishing that the colonies were so persistent in their efforts to set this industry upon its feet.

At that time the overwhelming pre-eminence of agriculture was the foremost disadvantage facing an enterprising man who endeavored to start manufacturing. In a new country, where soil and climate permit, the first activity to which men turn their attention is farming. They must eat to live, they must farm for food; hence this elementary need of human beings is always reflected in the primacy of agriculture among all industries. In America this natural predilection toward farming was heightened by the fact that the middle and southern colonies produced commodities for which they had either an exclusive monopoly or for which an excellent market existed. Tobacco was an American plant, and Virginia with her neighbors had a virtual world monopoly in its cultivation. Since the profits in the business were great, Virginians refused to consider any other form of industry, with the result that although they lived in a wooded country they imported from abroad all their wooden ware, even birch brooms. Pennsylvania and Delaware were the grain-growing and flour-milling communities for which the West Indies plantations and New England constituted valuable markets near at hand. New York was similar to Pennsylvania, while New Jersey was a grazing, cattle-feeding settlement. Consequently in all the colonies south of the Hudson, strong incentives were held before a man to devote his energies to farming. Land was cheap, the virgin soil was fertile, and a market was ready to absorb what was produced. It paid to ship raw materials and with them purchase manufactures from Europe. The commanding position of agriculture, therefore, held manufacturing in abeyance.

The poor showing of colonial manufacturing, however, was not entirely due to men's prejudice in favor of land tillage. Manufacturing had to struggle against a shortage of labor, a lack of capital, an absence of market, and exorbitant transportation charges. Added to all these natural limitations was the British policy of prohibiting any activity that threatened their own home workmen. The population of the colonies at various periods in their history is indicated in the following table:

COLONIAL POPULATION[1]

Year	Amount
1640	25,000
1660	75,000
1688	200,000
1700	250,000
1720	500,000
1740	1,000,000
1761	2,000,000
1775	2,243,000
1790	3,929,000

Labor Scarcity

In a country so sparsely settled, yet so extensive in area as America, it was natural that labor would be scarce. Land was to be had for the taking, so why should any man work for another? As a consequence wages were very high, ranging from two to six times the cost of living. A mechanic even as late as 1832 could save enough in four to six months to buy an 80-acre farm. Farmers could afford high wages because they had no capital outlay for land, hence no interest charges; there were no tithes and taxes were low; on the other hand, the land gave a large increase and the market absorbed all that was grown. Yet even farmers had trouble in securing permanent labor and had to resort to importing convicts, indentured servants, or slaves. If farmers in a superior situation could not secure labor, how much more of a handicap was it to manufacturers in an inferior natural position. It costs so much to train workers that manufacturers must have a permanent labor force, yet in America the high wages paid, plus the cheapness of living, enabled wage workers to set up for themselves as proprietors of land in two or three years' time. Hence a manufacturer's force was always a succession of learners, a condition that operated forcibly in restricting manufacturing enterprises.

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[1] Clark, V. S., History of Manufactures in the United States (1916).

Furthermore the labor was not massed in towns or cities but spread out thinly over a wide area. This was particularly true in the southern colonies where the type of agriculture demanded large land holdings but did not call for town facilities because each plantation-owner sold his own produce over his own wharves. At the opening of the Revolution there were only 3,000,000 people in

POPULATION IN THOUSANDS

Place	1701	1749	1775
New Hampshire	10	30	102
Massachusetts	70	220	352
Rhode Island	10	35	58
Connecticut	30	100	262
New York	30	100	238
New Jersey	15	60	138
Pennsylvania	20	250	341
Delaware	..		37
Maryland	25	85	174
Virginia	40	85	300
North Carolina	5	45	181
South Carolina	7	30	93
Georgia	..	6	27

the colonies and these were scattered all the way from Maine to Georgia, as shown in the table on page 33, from estimates printed in the Census of 1850.

The result of this wide dispersal of labor, together with its high price, effectively checked any tendency toward manufacturing.

Lack of Free Capital

Abundance of capital is as essential to manufacturing enterprises as an ample supply of labor. Just as the newness of America made labor well-nigh non-available, so also the recent origin of the colonies created a dearth of fluctuating capital. It is not true that there was an absence of capital in the colonies, but it is a fact that whatever capital was present constantly assumed fixed forms. It went into buildings, cattle, work animals, or tools, and left but little free to conduct a going business. Hence manufacturing might start, but it could not borrow capital for running expenses or for expansion. What small amount of capital was available constantly tended to flow abroad to pay for imports. The result of these facts in respect to capital is shown in the statement that in 1781 there were but three banks in America—one in Philadelphia, one in New York, and a third in Boston.

A lack of free capital might have been met by a system of long-term credits. But in a country so young, where capital was in such demand for establishing homes and farms, it was compulsory to make a small amount do a large aggregate of work; in short, the turnover of capital had to be large and quick. Hence long-term credits were unknown to American capitalists. The colonial efforts to provide a more elastic currency led only to inflation and high prices. Without labor, without free capital, and without credit, manufacturing could make but little headway in the colonial area. There was so little private enterprise that at the time of the Revolution Congress itself was forced to erect and operate the little forges and furnaces that furnished munitions of war.

Lack of Markets

Even if there had been an adequate labor force and a supply of capital, still there would have been little manufacturing in colonial America because of the absence of market. Our industry was still on the household basis; each homestead produced its own raw materials, manufactured its own necessities, and consumed its own products. There was no need or desire to leave the home place in order to satisfy men's wants. Furthermore, workers here were not paid in money but were rewarded in kind, whereas in England, money wages were compelled by law. Just as in biblical times Abraham gave Joseph a percentage of the increase in the flocks, so in America the miller took his toll in grain, the spinner in yarn, and the cobbler in food, leather, or agricultural products. The lack of money, then, operated against extensive exchanges at a distance, and trade was by barter between individuals. These two facts—the economic independence of farmers, and the absence of money wages—practically eliminated any general market. Hence a manufacturer was strictly limited to his own neighborhood, and even there was put to much inconvenience to dispose of his wares.

This feature of American colonial manufacturing was heightened by the difficulty of transportation; distant overland journeys were impossible because the country was a well-nigh trackless forest. The only means of easy communication was by water. Any place available to American manufacturers by water was equally accessible to European producers and since the people preferred the better made, better finished European goods, American wares could not compete.

Colonial ventures in this field of endeavor, therefore, were limited by the lack of labor, capital, market, and transportation. In addition, they were throttled by English law.

Handicap of British Law

England's policy toward her colonies was to encourage them to produce raw materials which when shipped to England were to be exchanged for English manufactures. In other words, England looked upon her colonies in the light of plantations to be regulated for her own benefit. It is easily perceived then, that the home country would frown upon all attempts of the colonies to make themselves independent, economically. Thus, when in 1731 the hat industry of America gave evidence of superseding hats of English manufacture, the English makers immediately petitioned Parliament for relief from this untoward competition. Despite the fact that the raw material—fur—was abundant and cheap in this country and that fully ten thousand persons were actively engaged in the business in New York and New England, nevertheless Parliament listened to the appeals of the English hatters, and in 1732 prohibited the manufacture of hats in the colonies. Likewise when the iron industry of England was on the decline because the forests that supplied charcoal fuel were exhausted, the colonists were exhorted to erect furnaces in order to supply England with pig iron. At the same time—the early eighteenth century—the settlers were forbidden to fashion the pig iron into any finished form whatever. Later when a substitute for charcoal was found by distilling soft coal into coke, an edict was issued against colonial manufacture of pig iron. Again in 1744, England invoked the majesty of the law to strangle American competition by declaring it a misdemeanor to ship the new marvelous textile machinery out of England. This law was strengthened at subsequent times to include the parts of machines or even plans. In short, England was at a more advanced economic stage of development than her colonies and she intended that the gap should never be lessened.

This policy nipped in the bud all those incipient manufactures that showed any likelihood of success in competition against England herself. Consequently, even if all other factors had been favorable for the development of manufactures in America, it is little likely that ventures of that sort would have survived the cold disapproval of English merchants or the harsh rigor of English law. This English attitude, therefore, added to the dominance of agriculture and the lack of labor, capital, market, and transportation facilities, made it impossible for manufacturing to gain headway in the colonies.

Local Industry

What little manufacturing resisted these various shocks, was almost entirely local in character. It derived its raw materials from near at hand, it transformed these materials into usable goods in the same place, and it sold the finished product in the immediate locality. The whole cycle of activities from crude stock to final form was carried on in the same area.

All such local industries had several common features. They dealt in articles too cheap or too bulky in proportion to their value to warrant importation. Furthermore, the manufacturing processes were simple, without much organization or subdivision of labor; consequently little capital was required. Finally, the commodities made were those that were in universal demand. For example, nearly every community boasted three mills—one for lumber, another for flour, and a third for finishing wool cloth. In small villages it was frequently true that all three were housed in one structure, not because of any similarity in process but for the reason that no one of them could keep the little water power equipment busy all the time. By combining the three, they were able to reduce the expenses of the building and power by sharing it with the others. If the sawmill, for illustration, were maintained by itself, it would have the entire expense to pay whether the mill operated two days a week or six; but if it were housed with a flourmill and fulling-mill, each would bear a third of the charges. The common need for power brought these three industries together upon the same or neighboring stream, even when economy did not dictate they be found under the same roof.

Besides these three types of manufacturing there was considerable manufacture of iron, for which the raw materials and the need for the products was everywhere present. The tanning of leather was another common local industry because the hardwood forest supplied the tannic acid and each farmer furnished the hides. Based upon the local supply of leather, shoemaking was a widespread activity. Textile materials—flax or wool—were spun into yarn in almost every household and woven into cloth by members of the family or by itinerant weavers. In many places too the burning of wood into potash, or its refined form of pearlash, was an ordinary practice. Surplus grain was nearly everywhere converted into liquors—the northern and western communities producing whiskey and hard cider, the ports distilling rum from molasses, while the middle states made beer. These local manufacturers, then, were the only examples of manufacturing enterprises to be found in the colonies.

To this broad generalization there was one outstanding exception. In New England, particularly Massachusetts, several other branches of manufacturing were of importance. In fact, New England was the seat of manufactures for all the Atlantic colonies.

New England was unlike her sister colonies in many respects. She could not support herself by agriculture alone and consequently had no agricultural surplus to export. She had no other raw material that England wanted except white pine for ship masts. Since there was no basis for trade between the mother country and her American namesake, New England as a result sought for wealth by methods that were not necessary anywhere else in America. Denied sustenance from the soil, she found succor from the sea, and, as the best fishing grounds in the world were near her coasts, New England gained fame from her fleets if not for her farms. The outgrowth of the fishing industry was the rise of commerce and shipbuilding as New England's sources of livelihood, and these two enterprises in turn were responsible for giving to New England many manufacturing ventures. Most of the manufactures orginated from the fact that they either supplied materials needed for shipping or else put into finished form raw materials brought home to America by returning merchantmen.

Ship Outfitting

In the first group fell all those manufactures that outfitted ships for their voyages. The iron industry was one of these, furnishing nails, bells, cannon, shot, and anchors, and it is significant that Massachusetts led all the other colonies in iron manufacture for a hundred years after 1650. Besides iron, rope was a requisite for ships. The first rope walk was set up at Boston in 1641 and soon all the ports followed Boston's lead. As a reflex of this early industry, one of the largest rope plants in the United States today is located at Plymouth, not far from the famous Rock. Not only iron and rope but food products also were needed by every outgoing vessel; flourmills, biscuit-makers, and salt meat packers were therefore common sights in every great shipping town. It is interesting too to discover that the present-day ready-made clothing industry has grown out of tailor shops that faced the docks and made suits for sailors. In this same group should be placed the big cooperage industry. Flour, biscuits, meat, rum, sugar, molasses, oil, and naval stores—in short, every principal article of commerce—was transported in hogsheads or barrels. Cheap wood of high quality gave New England such an advantage in cooperage over her foreign competitors that it was estimated our merchants could count the cheapness of their barrels as at least an extra 15 per cent profit. Our fortunate position was so pronounced that small pails, large buckets, hogsheads, and staves made of white oak were themselves articles of commerce, especially to the West Indies where they were needed for sugar, molasses, and rum. In 1671 New Hampshire alone sold abroad 20,000 tons of boards and staves besides ten shiploads of masts.

Distilling and Refining

Contrasted with these industries which supplied outbound boats were others that were supported by raw materials brought home by incoming vessels. Crude sugar was carried from the West Indies to New England and there refined for our domestic market. Likewise, molasses distilled into rum was at that time an especially valuable product in demand by farmers and sailors alike. It was as customary an article of a ship's stores as the sailors' biscuit and salt pork; in fact, it was usual to allow for the operating expenses of a ship, $95 to $275 a trip for rum, or as much as was allotted for bread.

Another distilling industry located on Massachusetts Bay was that founded on whaling and other fishing. For scores of years fish oil was the only source of lubricants and illuminants. The great fishing industry too called for large quantities of salt for preserving fish when caught, as well as for preparing food for sailors. Hence the refining of salt from sea water was a common practice.

Not only raw materials for distillers and refiners were in the holds of returning ships, but also hides collected from foreign ports scattered all the way from Cape Horn to Santa Barbara and many Pacific Islands in addition. These hides were tanned near Boston and manufactured into shoes at Lynn. Although shoemaking was a local industry in all the colonies, nevertheless Lynn soon was the leader in this industry and still is, even at the present time.

The fishing and commerce of New England, therefore, were responsible for the early trend towards manufacturing in that section of the country and marked it as an incipient industrial region, whereas in the other colonies there was slight indication of any future manufactures save what little may have been promised by the local industries.

Revolutionary War

Then came the Revolutionary War, ushering in a new era with different conditions from those of the colonial period. It may be stated as a general truth that whatever interferes with or interrupts commerce, produces an immediate incentive for home manufactures. War, embargoes, and high tariffs are alike in this respect; they interfere with trade between nations and just so far as their opposition is competently operative, by just so much do they encourage home enterprises. During the Revolution, as a consequence, the American market so long dependent upon foreign manufactures was suddenly thrown upon its own resources. Imports were shut off, with the result that commodities customarily imported increased in price. On the other hand, raw materials usually sent abroad were likewise cut off at the docks and thrown back to American consumers. With high prices for finished products and low prices for the crude stock, an alluring profit was held before American enterprise, in immediate response to which manufacturing was greatly increased.

Effect of Revolution

But this manufacturing endured only so long as the war which produced it, for when the war was finished a flood of British goods entered our markets and almost completely prostrated our young industries. The British had all the advantages of low wages, permanent working classes, great subdivision of labor, and relatively large-scale production, and moreover England had a monopoly upon technical improvements in both textile manufacture and iron production. In textiles, the spinning jenny, the spinning mule, the application of steam power to spinning, power looms, cylinder printing, and chrome bleaching, all were English inventions and had been introduced in England's factories exclusively; in truth they were the direct cause for the introduction of the factory system in place of the former home work. In iron and steel manufacture, the use of coke, Cort's puddling furnace, and Cort's grooved rolls were again English inventions. England kept these inventions for herself by imposing fines and imprisonment upon anyone attempting to carry them from the country in the forms of machines, parts, plans, or even the persons of skilled artisans. In addition to the superiority of the British position, the Americans had to face a chaotic political situation at home. Every state levied import and export duties upon goods entering or leaving its bounds; hence manufactures were confined to their own state for a market. So our young manufacturing enterprises swayed, tottered, and almost crashed into complete ruin.

Against this array of benefits belonging to Britain, the Americans could set the distance that separated English producers from American consumers, freight rates acting as a tariff in favor of Americans. In addition the Americans were blessed with low taxes and low-priced materials. The federal law in 1792 and later state laws exempted men from military service if they worked in glass, iron, or silk plants. In the long run these advantages counted against the British after we had smuggled, stolen, or invented machinery to offset the British advantage in this respect, although at first with all the goods on hand accumulated during the war, the British were able to sweep our market. Moreover, the American situation was soon relieved by the international upheavals wrought by Napoleon. These benefited England by shutting off continental competition and giving her free reign to develop her own industries. Since she had the

European markets, England was less concerned with the American. At the same time American commerce profited amazingly by the struggles abroad and brought to Americans much capital that they sought to reinvest. Although much of it went into the enlargement of shipping facilities, some was diverted to the support of manufactures. This tendency was greatly increased by the Embargo (1807) and Non-Intercourse (1809) Acts which shut off foreign importations and completely tied up our own vessels. Merchants withdrew their money from commercial ventures and put it into factories, the exclusion of foreign-made goods giving them an excellent opportunity to succeed. The War of 1812 following soon afterwards was the final factor favoring new manufacturing projects.

Factory System

The situation of American manufacturers during and after the second war with Britain differed in two marked ways from the first. The Revolution had brought an expansion of household manufacturing, but the War of 1812 firmly established the factory system in the United States. For illustration, the first complete cotton factory of America was erected in Waltham, Massachusetts, in 1814, and the power loom dates from the same time and place. Before the War of 1812 there were but a few small cotton-mills and these made yarn for the purpose of selling it to household weavers, but after the war large mills or factories carrying on both spinning and weaving were set up on the greater rivers. Lowell and later Lawrence are examples of this development. The second characteristic that made 1815 different from 1782 was the rapid subsidence of the sudden fierce foreign competition that arose at the close of the war. The dumping of articles of alien manufacture in our markets did not continue for any great length of time. We were not in the weak condition that prostrated manufacturing after the Revolution; our political status was no longer chaotic —our internal affairs had been adjusted. Then, too, American money to pay for foreign goods was soon exhausted and our credit was no good, so we could not make purchases abroad even when we so desired. Finally, the English had enough business at home in their peaceful conquest of continental markets and consequently did not bring pressure to bear to save the American market. Since the period of suffering for American factory-owners was not greatly prolonged it merely weeded out the weakest and left the strong in a good position to seek control of their own domestic market.

We are prone to look upon the English as invaders of our field of operation in these two commercial contests after political wars; we speak of their efforts to regain a foothold here as "raids." As a matter of fact, it was the English who, previous to 1776 and largely before 1812, had possessed this market; so their struggles were really to protect what they considered their own. We were the upstarts who routed their commercial forces and finally drove them back into the sea, claiming for ourselves a market that had never before been ours, but which we naturally considered to be our lawful prize. The fields in which our inroads upon the former English prerogatives were most successful were cotton and iron manufacture. Between 1814 and 1830 these two became thoroughly a part of our economic structure and defied foreign competition to dislodge them.

Why the cotton industry should so early and so easily shake off alien domination is not difficult to explain. Of all the great manufacturing projects, cotton was the only one that came into existence after the shift from hand labor to machines or the change from houses to factories. Any operation calling for skilled male manual labor would have failed in America if forced to fight against foreign competition because our male workers were few in number and highly paid. But cotton manufacture was not only conducted by machines but demanded unskilled female attendants. Of these there was no dearth, for up to the opening of the Waltham cotton factory there was no means by which a woman could be economically independent, yet there were scores of widows and unmarried women who were galled by the necessity of appealing to male relatives for charity. These women hailed factories as their liberators from economic slavery. To their number were added the young women who were attracted by the spirit of adventure or the desire for an extra or a personal income. Hence the usual handicap against a manufacturing undertaking, namely, the lack of labor, was not existent in the case of the early cotton-mills. The lack of capital, too, that heretofore had checked the growth of manufacturing was removed from the organizers of the cotton industry, for the expansion of the factory idea came at just the time when there was a contraction in commercial profit and merchants sought new avenues of investment.

Water Power

With labor and capital requirements satisfied, the next requisite was water power. Eastern United States, especially New England, is splendidly endowed by nature with power sites, so no difficulty was raised on that score. The place that brought together labor, capital, and power was the natural location for the new industry and New England was that place. Sailors' wives, sisters, or daughters, or the female members of farmers' families struggling against debt upon an unproductive farm, constituted the labor. Boston, Salem, New Bedford, Providence, and New Haven were commercial capitals, and, as such, contained many a citizen of wealth anxious for lucrative investments. Countless brooks, small streams like the Blackstone or the Quinnebaug, and larger rivers, such as the Merrimac or Connecticut, furnished the power. As a result New England immediately took the lead in cotton-making and has never been jostled from that position.

The success of cotton factories was also due in part to the fact that Americans were accustomed to wearing light clothing. Before the Revolution, England, careful of her own wool industry and unsuited to cotton cloth by her climate, had prohibited the sale of calico from India within the British Isles; but wishing to support one colony at the expense of the other, she had encouraged the sale of calico in America. Since this cloth fitted our environment, it was eagerly received here. Our habit of using light materials paved the way for cotton goods, because we did not have to educate ourselves in the handling of a new product. The early mill-owners were wise enough, however, to make little attempt at the very first to produce fancy goods. Their product had no pattern either in design or weave, but was a plain, heavy white cloth, standard in character and suitable for uses, such as sheeting, that were in constant demand. The early adoption of this standard universally required cloth accounts in a large measure for the immediate success of our cotton factories.

This success may be measured by the increase in the number of mills and by the rapidly mounting consumption of raw material. In 1810 there were but 87 mills in the United States, but by 1826 there were no less than 400. In 1811 our mills consumed 17,000,000 pounds of cotton; in 1831 the amount was 77,000,000 pounds, a fourfold increase in twenty years.

Not only cotton but iron manufacture also, emerged from obscurity between 1814 and 1830. The reasons for the growth of the iron industry were the large demands for iron tools upon the rapidly multiplying farms of the Middle West and the use of iron in textile and other machinery in shops whose sole output was machines. The iron industry, however, did not make any such startling strides as the cotton, nor as it itself did in a later period when railroads greatly increased the use of iron.

The wool industry struggled along in the wake of cotton, but far behind it. For instance, power weaving became common in cotton manufacture after 1814, but not until 1830 in wool. There was no staple standard wool cloth and its sale was too subject to vagaries of style to warrant large-scale factory output. Moreover it was still bound by the necessity for skilled male employees, so it did not share the early success of its sister textile industry.

Although other industries had hardly shaken off the shackles of domestic production, yet as a nation we became more self-sufficient in this period before 1830. This fact is shown by the following table[2] of imports per capita:

IMPORTS PER CAPITA

Period	Amount
1791-1800	$8.25
1800-1810	9.90
1810-1815	8.00
1815-1820	3.50
1820-1830	5.10

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[2] Clark, V. S., History of Manufactures in the United States (1916).

Despite a larger population, our imports were much less per capita in 1830 than they had been in 1800.

Transportation

After 1830 and before the Civil War many changes that improved the opportunities in manufacturing took place; the chief among them were the introduction of railway transportation, the elimination of the fear of labor shortage, the expansion of the domestic market, and the invention of new machines.

No other influence so profound as the building of railroads has ever been brought to bear upon American manufacturing. Railroads permitted the segregation of manufactures into places where they could be conducted most economically; railroads broke down the necessity for purely local industries; railroads opened the whole great length and breadth of our country as a market for a manufacturer located anywhere within it; railroads created new markets not only for their own needs but in the hitherto inaccessible regions too remote from the highways of commerce to warrant settlement; railroads enabled manufacturers to draw upon the whole country for raw materials; railroads permitted large-scale production with its economies; in short, modern industry would be impossible without this all-essential connecting link. Of course the full effect of the changes just indicated was not felt in the period between 1830 and 1860, for railroads did not penetrate the trans-Mississippi region until after the Civil War, but the relative influence upon the manufacturing of the time was as great as at the present day.

One of the effects the early railroads had upon manufacturing was the enlargement of the labor force. The railroads brought middle western farms in competition with New England and New York. These farms had been hard hit already by the Erie Canal, but the railroads delivered a finishing blow. Farms in the East were abandoned to their fate and their former owners sought refuge in factories. Labor seeking factory jobs was a novel experience for America where manufacturers were accustomed to combing the highways and byways to induce workers to accept places in the mills. But the railroads did more than this; they gave an impetus to the use of farm machinery by opening territories where it was impossible to secure agricultural labor. The machines in turn freed farm laborers everywhere, and these former farm servants too drifted to the factories. Then the railroads extended dazzling opportunities to immigrants by making public lands available for settlement, thus starting an immigrant flow that the factories tapped to good advantage. After 1830, therefore, labor shortage was no longer so acute.

The railroads also brought a greater market to the factory doors. Farmers differentiated their crops into those sold for money and those used to supply home needs. The abandonment of general farming in favor of money-crop-agriculture created a demand for all those things each farmstead had formerly produced for itself. The railroads multiplied the number of farms, too, so by this means alone the home market for American factories was greatly enlarged. Furthermore the whole population of the country was increasing rapidly. In 1840 we had 17,000,000 people, but by 1860 our population was 31,000,000. Consequently factories were assured of a ready sale for their products and a continuously greater sale each year because the country was filling with people and industries were increasing and becoming specialized.

Capital

Factories were able to respond to these incentives because capital had become easier to get. The discovery of gold in California in 1849 soon made itself felt in the money marts. For the first time in our history it was easy to borrow capital at low interest rates. This condition came at just the right time to finance the expanding industries of the country.

Fully as important as easy money was the introduction of new machinery. Irrespective of the countless technical improvements inaugurated in many industries of the time, the outstanding advances hinged around two machines. Beginning in 1830, steam engines commenced to supplant water power as the motive force of our factories, because by that year our smaller streams were used to their fullest capacity and we did not then have the knowledge or methods for effectually harnessing larger rivers. Expansion of industry, therefore, depended upon steam engines. The other important machine was that for sewing. This invention has revolutionized industry to a degree not generally appreciated. Without sewing machines—whose production alone was a substantial addition to our manufactures—we could not have factory-made shoes, ready-made clothing, men's and women's underwear, or collars and cuffs. Sewing machines also were made on the principle of interchangeable parts and the experiment proved so astonishingly profitable that it was readily adopted by other industries, such as watch-making and agricultural machinery. So all told the sewing machine deserves very honorable mention in the chronicles of American industry. Steam engines, sewing machines, and the principle of interchangeable parts, these three great influences bearing upon manufacturing at the same time, pushed it forward rapidly in the economic life of our people. Between 1810 and 1860 the aggregate value of manufactures increased tenfold, whereas the population increased only five times. Manufacturing which had made but a slight impression upon the nation in 1830, engaged directly or indirectly nearly a third of our entire population by 1860.

Civil War

Despite this showing it cannot be said that the United States put the full weight of its potential powers for manufacturing into action until after the Civil War. Within the last fifty years we have come to realize the extent of our resources upon which manufactures are supported; in this half century also many new resources have been unearthed; in the same period our transportation has become settled and an extremely high tariff has fostered new enterprises. In addition the domestic market has been greatly increased by the rapid settlement of the continent. These facts, together with the development of national advertising, and the energizing force given to business by the circumstance that our industries have been pushed to success by the men who founded them—that is, their businesses were made by themselves, not inherited from ancestors—help explain why manufacturing has shot ahead so greatly that, in place of being merely an agricultural nation, we are today one of the greatest manufacturing countries in the world.

Farm and Factory

A strange misconception regarding the relation between agriculture and manufacture has rooted itself in peoples' minds. It is generally supposed that these two industries are antagonistic and that the one can grow only at the expense of the other. For example, it is a notorious fact that much factory labor was recruited from the farms, and this is taken to prove that factories compete with farms to the detriment of the latter. In reality fields and mills are as closely connected as man and wife; each is dependent on the other for the fullest realization of its being. (Farms are the greatest known resources for factories; more than mines, more than forests and quarries, more than any other source, the soil supplies raw materials for the manufacturer. Farms furnish more than three-fourths (79 per cent) of all the materials upon which factories work. On the other hand, farmers have no other single market for their products so important as the mills that dot our land. Fully a half of all the products a farmer raises for sale are purchased for use in our manufacturing plants. Hence a nation that sets for itself the task of leading the world in manufactures is fortunate indeed to have its factories backed by a multitude of farms. Conversely, an agricultural community is blessed by the presence within its confines of manufacturing enterprises. Since no other great nation is so abundantly endowed with farm land per capita as the United States, no competitors of ours in manufacturing are so strengthened by the presence of this greatest of factory resources. Measured per capita, our farm land is six times that of Russia or France and nine times that of Germany, the United Kingdom, or Austria Hungary. Put in another way, the United States has 19 acres for every man, woman, and child within it, while the United Kingdom has but 1.9.

Manufacturing Resources

The manufactures most benefited by our extensive farm lands are the textile industries. The three principal textile raw materials are cotton, wool, and flax. In cotton production the United States leads the world, for more than half of the world's output comes from our southern states. For wool, although we are not so favorably situated as for cotton, nevertheless we have more sheep per capita than any other nation except the United Kingdom, Argentina, and Australia. Flax requires cheap labor, consequently we cannot grow it, but there is always the possibility that flax culture will be put upon a machine basis, and if so we could rival the world as we do for wheat and as we do already for flaxseed (linseed). The world's production of flaxseed today is divided as follows: Argentina 25 per cent, Russian Empire 19 per cent, India 20 per cent, United States 18 per cent, and all others 18 per cent.

Our farms not only give our textile factories large amounts of raw materials, but also supply all those industries dealing with food stuffs. These range all the way from tiny tomato canneries of local importance only, to great plants like Heinz, known all over the nation. The food industries group also includes small or great flourmills, tiny or enormous meat-packing plants, and little or big sugar refineries. Farm products, furthermore, are the basis for our tobacco industries—plug chewing tobacco factories, smoking tobacco, cigars, and cigarettes.

Mines

Next to our farms as resources for manufacturing, come our extensive mineral deposits. One-third of the coal, one-fourth of the iron, and one-half of the copper of the world are found in the United States. No nation has become great for manufactures without cheap power, and the usual source of cheap power is abundance of coal. In gross amounts, no other nation is so bountifully supplied with coal as the United States, and in coal per capita (5.4) we have but one superior, namely, the United Kingdom (6.5 tons per capita). We mine over 500,000,000 tons per year, while the United Kingdom lifts but half that amount from the earth. Largely because our iron ore mines are the greatest in extent, highest in grade, and easiest mined, our iron and steel industry outranks that of any other nation. Our copper mines support the brass industry and the electric machinery manufacture. Our unrivaled petroleum deposits make us the leader in the products refined from crude oil. Our raw materials for cement manufacture, everywhere abundant, help explain the sudden amazing growth in the utilization of concrete. In short, 15 per cent of the raw materials used by American manufacturers comes from American mines.

Forests

The remaining 5 per cent (agriculture 79 per cent, mining 15 per cent) is supplied by our forests. In this resource no other great manufacturing nation is so well furnished as we are. Wood is the raw material used for a wide range of factories beginning with wooden dolls or toys and ending with victrolas, or beginning with baby carriages and ending with ships. Wood is also the material from which all newspaper and most magazine paper is manufactured. Tanneries depend in part on the bark of trees for their tannic acid.

Farms, mines, and forests, all natural resources, have poured forth a stream of wealth that flowed into our factories and floated them high upon the tide of success. The rapid development of American manufacturing is due then, in part, to the variety, character, and amount of resources placed at the disposal of our business men, and in part to the extensive building of railways.

Betterment of Transportation

Before 1860 our railroads barely reached the Mississippi River, but since then, three transcontinental lines have been built. The great Middle West too has added road after road until that section has as dense a railway net as can be found in an equal area anywhere. The eastern states have not been behind in building feeders to the trunk lines, and developing interurban transportation. Hence a whole continent has been spread before our manufacturers; every part of the nation is accessible to a factory, no matter where the factory is situated.

Since 1860, therefore, the words "domestic market" have included every part of the United States, and the size and extent of the country has made this market without a peer. The mere size of the United States has insured variety in population, differences of climate, unlikeness of resources, and divergencies in the stages of economic development. Every one of these things has stimulated manufacturing, for the variety of peoples has called for a variety of products to fill their needs; differences of climate have demanded different clothes, food, and shelter created by different factories; unlikeness of resource has assured unlikeness of occupation, hence giving a basis for trade; and divergencies in stages of economic development have meant that the more advanced must supply the wants of the less advanced. Railroads with unrestricted interstate commerce over a wide area have brought about this condition so favorable to manufacturing.

A great country with a common language gives unusual opportunity for advertising. Our business men have not been slow to seize this advantage and it in turn has reacted upon the success of plants by bringing a flood of orders to those that captured the public's good-will. National advertising has been no mean influence in establishing American manufacturing upon a solid basis of prosperity.

Tariff Protection

Another influence at work since 1860 to promote manufactures, an influence ranking in some minds with that of resources or railroads, is the tariff. Since the Civil War we have had an abnormally high rate of import duties and this undoubtedly has called into existence, or protected in their infancy, many manufacturing industries. Well-versed manufacturers, however, claim that a tariff makes little difference to them whether it be high or low, so long as it is permanent. A stable low tariff would be as good as a continuously high tariff, if a manufacturer could be assured that changes would not be made. Our actual tariff history with its frequent fluctuations, therefore, is said to have been principally influential in promoting instability of industry.

Almost as important as any factor, in accounting for the success of American manufacturers, is the fact that the directing officers are the men who established the business. A concern in the first generation has a greater chance to succeed than one that has been held in a family for some time. There is a trite saying that a man gets out of any association what he puts into it. Since the founder of a business gives it a full share of his energy, his time, and his brain, the chance of success is increased, but inasmuch as the man who inherits a going concern usually has acquired interests outside of it, or in any case cannot share in the joy or pride of its creation, the business suffers. To such a man the business is not his own child but only one he has adopted. Heredity also plays strange pranks. There is no guarantee that a successful father will have a successful son, because the boy may inherit, say, his mother's artistic instincts rather than his father's business acumen, or, if both father and mother are the business type, the son may revert to a previous ancestor whose abilities turned entirely in another direction. So there is always a great risk when a concern passes from the control of the man or men who made it. The fact, then, that our American enterprises have been in the hands of the men who brought them into existence has been a decidedly strong influence in their favor. One of the principal advantages derived from this first-generation aspect of our business is the freedom with which experimentation has been conducted. Our business men have not been shackled by tradition; they themselves were pioneers, hence were not afraid to try new things. This willingness to learn and change has kept business plastic and hence permitted its growth. In other words, our industry has not hardened or crystallized, but has kept itself free to find new profit in novel ventures. New methods, machines, or products have a strong appeal to Americans because they are a new people in a new country.

Modern Progress

The last fifty years have witnessed a marked change, therefore, in American manufacturing. The betterment of transportation, the size of the domestic market, the value of tariff protection, and the freedom from tradition—all these have acted together to stimulate manufacturing into a leading place among American industries. The result is that in 1910, 80 persons in every thousand were engaged in manufactures, whereas in 1870 only 33 were so employed. Agriculture, meanwhile, has shrunk from the commanding position where it employed 152 out of every thousand people, to requiring the services of but 130. Put it another way, in 1870 there were four persons working on farms to every one engaged in a factory; in 1910 there were 1.6 farm employees for every one engaged in a factory. A comparison between the United States and the rest of the world before the Civil War would have portrayed American manufactures in a sorry plight, but a contrast today would show the United States as the leading manufacturing nation of the world. A third of the world's manufactured products are made within our bounds; no other nation has more than a sixth. This is not often appreciated because we manufacture for ourselves, whereas other nations make goods for export. But reliance upon a home market will not long continue. When we reach out for foreign markets, a new era in the history of our manufacturing will commence. Then this nation which had little if any manufacturing before the Revolutionary War, which became partially independent in cotton manufacture before 1830, which began to feel its power in all branches of manufacture by 1860, and which since the Civil War has swept forward with a rush to control a continental market, ought to be able to continue its progress in manufacturing until no other country on earth equals it.

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CHAPTER III

THE LOCALIZATION OF INDUSTRY

Causes

"Pill alley" was the undignified nickname for an otherwise stately, elm-arched street in an old college town, the sobriquet finding favor because nearly all the doctors of the town lived side by side upon that one street. Later experience has shown the author that this was not an isolated example but that similar to birds of a feather, professions or business tend to flock together. Dentists as a rule hive in one office building, opticians open their shops along the same thoroughfare, department stores crowd about some one vantage point, wholesale leather dealers jostle each other in their neighboring warehouses, and wholesale wool merchants congregate near a common marketplace. Manufacturers, too, show the same tendency. More than three-fourths of the collars and cuffs made in the United States come from Troy, New York; silver plate to a like degree is manufactured at Meriden, Connecticut; tanning is centered at Milwaukee, Wisconsin, and the home of silk-manufacturing is Paterson, New Jersey. These facts seem contrary to common sense, for apparently a business would be most assured of success where it had no competition in the immediate neighborhood, but in reality industry thrives best where it throngs most. It is worth while, then, to find out how localization starts and grows, and what advantages it offers.

Some localized industries have started as a response to resources either in raw materials and power or in unskilled labor, while others originated in particular places because they were near to their market. A few were permitted the choice of a desirable strategic location by virture of a monopoly power, but the great majority owe their present importance to an accidental start.

Raw Material

The presence of raw materials has been a potent factor in giving rise to localization. For example, Chesapeake Bay is the greatest oyster field in America and as a result Baltimore does more than two-thirds of the oyster-canning business of the United States. One might generalize and say that as a rule the preserving industries localize near the source of their materials. This explains the Columbia River salmon canneries, the former wine plants of California, the grape juice factories of northeast Pennsylvania or northwest New York, the sweet corn canneries of Maine, the tomato canneries of New Jersey, and the slaughter-houses of Chicago.

Not only perishable raw materials but also those that are bulky, heavy, or fragile, tend to collect factories near the point of their origin. Thus the heavy cement rock of the Lehigh Valley is transformed into the Portland cement used to build skyscrapers in New York, Philadelphia, and other cities along the Atlantic coast, while the bulky, easily broken drain tile they need is made in Perth Amboy, New Jersey, whereas corn-belt farmers buy their drain tile in Ohio.

Continued Concentration

It has frequently happened that industries called to particular places by resources in materials have remained where they started long after the local supply of crude stock has disappeared. Among the novel products carried home to Boston, Providence, and New Haven by the far-roving Yankee sailing vessels was Amazon rubber. The presence of this raw material gave rise to rubber-using industries in or around all three of these cities, the goods made ranging from overshoes to fountain pens. Although crude rubber is seldom seen today on the docks of these maritime cities, nearly all the rubber overshoes, boots, or arctics made in the United States are produced in their locality. A half-dozen plants now belonging to the United States Rubber Company and the factory that turns out Waterman Fountain Pens are all in one narrow valley adjacent to New Haven. There are many rubber plants within hailing distance of Providence, while Boston is girdled with them. Likewise the plated jewelry industry is centered in or near Attleboro, Massachusetts, just outside of Providence, Rhode Island, because gold and silver from Spain, Portugal, and the West Indies once were borne into Providence by home-bound commerce carriers. During the Great War, Bridgeport, New Haven, and Hartford became world famous for rifles and revolvers, an industry long established there because at the opening of the nineteenth century western Connecticut produced a grade of local iron that was peculiarly adapted to making weapons or edge tools. In all of these cases, the present-day greatness of the industries entirely overshadows the fact that they came to the regions originally because raw materials were easily secured at those points.

Water Power

Water power is a resource that has drawn many industries into compact units around desirable sites.

One-third of the knit underwear made in the United States is furnished by the towns in the Mohawk Valley near Cohoes, New York, due to the circumstance that the first power knitting machine took advantage of the large water power resource available there. American writing paper manufacture centers at Holyoke, Massachusetts, because the Connecticut River at Holyoke furnished the greatest water power in New England. The falls and canal systems at Holyoke also caused local engineers to enter the field of power machinery manufacture, so that later when Niagara was bridled, the great turbines that turn Niagara's energy into electricity were made at Holyoke. The large number of rapids and falls in the Merrimac River attracted to its banks the largest cotton-mill in the world at Manchester, New Hampshire, the largest woolmill in the world at Lawrence, and one of the principal cotton manufacturing cities of the United States at Lowell; no other stream in the world turns so many textiles spindles as the Merrimac. Power then, as well as raw materials, is responsible for the origin of many localized industries.

Labor Supply

An unused labor supply also acts as a magnet in attracting mills to a common point. Wherever an industry has collected a large working force of men, a situation favorable to industries using female labor is created because women relatives of the men are glad to get jobs whereby they may increase the family budget or attain individual economic independence. Hence silkmills have invaded the coal-mining regions to such an extent that Allentown, Pennsylvania, in the Lehigh Valley cement district, is rapidly gaining on Paterson, New Jersey, in the manufacture of silk, while Scranton, Pennsylvania, the best known anthracite mining town, follows close behind Allentown. Industries of this sort are called "parasitic" because they utilize a labor force collected by some other activity.

Proximity of Market

Other localized industries have started because a large market near at hand gave the necessary incentive, a case in point being the manufacture of agricultural implements. This industry has followed the grain belt westward, once along the Atlantic, then in interior New York, and now in the Middle West, centering at Chicago because that city has easiest access to all the great agricultural states of the upper Mississippi Valley. Today the state of Illinois claims 39 per cent of the entire nation's product.

Topography

In New England where there are scores of instances of localization, topography seems to have had a controlling influence in bringing about the condition. Since most of the early mills were attracted to water power sites, the manufacturing industries clung to stream valleys. These same valleys were usually the arteries of communication because travel overland east or west across the general north-south trend of the valleys was rendered arduous by the maze of hills or mountains. It could quite easily occur that valleys near each other geographically would be actually remote socially for the reason that communication between them was checked by steep hill roads. Consequently an industry started in one valley could readily spread up or down that valley but be unknown and untried in another near at hand. The Blackstone valley concentrated on textiles, the Quinnebaug on edge tools, the upper Connecticut on paper, the lower Connecticut (geologically) from Hartford to New Haven on hardware, while the Naugatuck specialized on brass. Topography then must be included among the various causes that have given rise to the localization of industry.

Chance

But more than resources, more than labor, more than markets, or topography, more than any other reason for the start of localized industry, we must recognize the force of chance. Westfield, Massachusetts, now manufactures over two-thirds of our whips because one irate farmer incensed by his neighbors' pillage of his willow hedge to belabor their horses, cut the willows himself, bound them with twine, and sold them to the erstwhile plunderers. That started an industry that has since made the town conspicuous. The position of Lynn in the shoe industry, the center of a circle of towns manufacturing a fourth of the shoes worn in the United States, is partly due to the chance settlement there of a Welchman named Dagys, the most skilful shoemaker in the colonies. German Palatinates, skilled in the art of knitting, fleeing to America found congenial religious refuge in Penn's settlement of Philadelphia. Once established on our soil they set about their accustomed trade and soon made Germantown (part of Philadelphia) famous throughout the colonies for its stockings. Today, as a result, Philadelphia manufactures more hosiery than any other place in the country. The list of illustrations might be lengthened, but it would prove only more conclusively that accident is the most influential factor in determining where a localized industry will come into being.

Monopoly

However, one other factor, that of monopoly, must be mentioned. In modern industry we are familiar with the spectacle of one corporation or group of allied companies, gaining such ascendancy over the whole trade that arbitrary decisions replace the usual give-and-take of competition. It is obvious that such a monopolistic control may choose the most desirable locations for its plants in order to concentrate its efforts in the few most advantageous places. The limitation upon the number of factories and the large output in a few selected towns or cities bears a close resemblance to the localization of industry.

For instance, practically all of the oil-refining done in America is carried on in a half-dozen great plants, some on the Atlantic coast, some in the Central West, and some along the Pacific. Similarly, sugar-refining is confined to a few strategic points. The manufacture of shoe machinery is likewise confined to one town (Beverly, Massachusetts) in the heart of the greatest shoemaking district. In every case, the localization is entirely artificial and could be annihilated by an adverse court decision or the expiration of patents. Before the Standard Oil Company gained its supremacy there was no localization of refineries; the American Sugar Refining Company is responsible for the localization of its industry; and if there were no United Shoe Machinery Company, every machine tool center in the United States would have the possibility of entering that trade. So localization induced by monopoly is only as permanent as the parent corporation that gives it birth. It is undoubtedly economic and profitable but if competition were given full sway, monopoly-localization could not endure. In England, it may be remarked, many of the localizations date from the days of guilds in the eleventh to sixteenth centuries. These guilds had monopoly privileges, one of which was the limitation of certain industries to particular guild districts. Having gained an early start some of these original monopoly centers have maintained their supremacy.

Family Control

Whatever was the cause of their inception—raw material, power, unused labor, a nearby market, accident, or monopoly—all localized industries have shown similar methods of growth, have profited by like advantages, and suffered by reason of analogous handicaps. How a localized industry grows is a more important consideration than how it starts.

Many industries have become localized because they are family affairs, and the family has remained in one section of the country. A father in business with several sons often establishes those sons in branch plants or associated lines, which, growing to prominence around the original plant, give a reputation to the locality for that particular business.

For instance, the cotton manufacturing industry of southeastern New England has always been associated with the names of Slater, Borden, Sprague, or Knight; the cotton manufacturing of the Merrimac River is just as intimately connected with the Lawrence family; while at the present time Chattanooga, Tennessee, is developing into a cotton-mill center under the leadership of the Thatcher brothers and sons. In colonial America no iron-making project was said to be complete unless a Leonard was in control, and the great brass industry of western Connecticut is the outgrowth of the Scoville, Benedict, and Burnham families.

Shop Association

By means of shop association as well as through blood bonds, an industry increases in importance in the town where it first starts. Superintendents or foremen may be considered as members of an "industrial family," just as sons are the heirs of their fathers. When an experienced superintendent decides to become his own boss oftentimes he finds that he can best succeed in the shadow of the plant where he was once an employee, because in a strange place he is unknown, but in the town where he has worked for years the bankers know and trust him and the business he purposes to enter is a tested proposition. It has been stated that every cotton-mill started between 1790 and 1814 was by men who themselves had been trained by Samuel Slater at Pawtucket, Rhode Island. Growth of this kind, through former workmen, has made Trenton the seat of pottery manufacture, and Gloversville the chief center for the manufacture of men's gloves.

Local Investment

Timidity of local capitalists is another cause for an industry's expansion in a particular place. Many men with small amounts of money to invest are afraid to risk their funds in any project unless they can keep it under daily observation, but they encourage new ventures in their own town as long as there is promise of profit. When New Bedford whaling captains saw their own business declining, they witnessed the great strides that their close neighbor, Fall River, was making in cotton manufacture but the old whalers absolutely balked at furthering enterprises in another town. Instead they put their money into cotton factories in New Bedford itself, with the result that today New Bedford stands at the head in this industry both for quantity and quality of output.

Division of Manufacture

Sons, superintendents, or local capitalists promote the early growth of an industrial center, but the mature advance is occasioned by the multiplication of allied industries, the increase in the number of supply houses, or the presence of plants utilizing wastes.

Instead of attempting to manufacture an entire shoe, many plants in Lynn or Brockton confine themselves to making heels, counters, box toes, or soles; similarly in Lowell, New Bedford, Philadelphia, and other textile centers, there are enterprises that specialize in originating patterns or designs, others which prepare warps for looms, and yet others that produce spools or cops to hold threads. The greatest source of automobile accessories is Detroit, which is also the largest producer of automobiles. Philadelphia, one of the chief textile centers of the United States, has more dye-houses than any other city. About two-thirds of the needles and pins of American manufacture come from Connecticut, the state that supplies the brass of which needles and pins are made. The home of the sewing machine is Bridgeport, Connecticut; corsets, almost entirely a sewing machine product, also come from Bridgeport and New Haven.

The close union of independent and dependent mills is one of the most striking features of our manufacturing industry. Ventures of these kinds would meet with little success if they were attempted anywhere but in a community where the main industry was localized, because the expense of reaching a market would exhaust all profits. On the other hand, the presence of shops specializing in parts of the main product aids the larger factories, for it enables them to purchase supplies right at hand. The large and small enterprises are also a benefit to each other, because by subdivision of product and by greater specialization the costs of production are reduced, so that outside competition is easily met. Partly finished material is also produced at the very doors of the factory that will complete it for market; hence transportation charges are reduced and annoying delays in delivery obviated. Consequently an industry once thoroughly established in a locality is assured of a steady advance.

Waste Materials

Localization, furthermore, attracts to itself plants whose business is the utilization of waste products. In order to insure a plentiful supply of raw material upon which to work, these shops must be where there are many factories creating the same sort of waste. An instance of this form of economy may be witnessed in the largest steelmill in the United States at Gary, Indiana, which has as its complement a great cement plant at Buffington, Indiana. The cement is manufactured from slag, the scum of impurities taken from the ore when iron is smelted and which ordinarily has no value, but on the contrary is one of the greatest nuisances to clear out of the way. It happens, however, that slag usually contains sand, clay, and lime, the three materials that compose cement, so by grinding the slag and mixing the three constituents in the correct proportions cement may be manufactured. A cement plant corollary to a steel works, therefore, rids the premises of the accumulation and at the same time turns what would be a cost into a revenue-producer. Another illustration of the utilization of waste is seen in New York City, the nation's tailor-shop. The short ends of cloth are carried to adjoining cap shops, an arrangement that is advantageous to cap-makers, as well as to the tailors, because it saves a cutting and allows a wider range of cloth patterns than the manufacturer could afford if cloth were purchased in the whole piece. Again, at the city of Gloucester, Massachusetts, one of the world's most famous fishing ports, the heads and tails of cleaned fish are carried by the dray load to a factory that is famous as a producer of glue and mucilage. Waterbury, Connecticut, also, around which city half of America's brass is made, has a "brass laundry" where small pieces of scrap and shavings are washed to recover the machine-shop oil, to separate brass from other metals, and to make the recovered brass available as raw material for recasting. This "laundry" handles 20,000,000 pounds of brass shavings per year and adds a value of 5 to 15 cents per pound.

Wherever such waste-using plants appear, they add an increment to the importance of a locality as the center of an industry, for by transforming liabilities into assets and turning costs into profits, they aid in the defense of the community against the onslaughts of outside competition and consequently augment the growth of the industry in the location where it is already rooted.

Prestige

After a town has become thoroughly identified with an industry its name has such an advertising value that new concerns seek it instinctively in order that the prestige of the place may bolster their own reputation. Detroit is the Mecca for incipient automobile manufactures, the name "Brockton" lends quality to a shoe, and New Bedford stands for high-quality cotton. The multiplication of small plants attracted by the mere name of a town adds to the renown already attained by the community.

Skilled Labor

But what is the secret for the success of plants that swarm into one place, fiercely competing with each other and watching, hawklike, for each advantage? How can they profit in such close union?

One of the principal outstanding facts in regard to localized industries, is that almost without exception they depend upon highly skilled labor, a circumstance that helps account for their paradoxical prosperity. An adequate supply of especially trained labor is the foremost advantage enjoyed by the individual units that comprise a localized industry. If one plant desires to expand it can draw upon the reservoir of labor already created. All the factories in the town are constantly filling this reservoir because each mill is a training school for the others. The young boys upon leaving school follow in the steps of their fathers, learning by actual experience in the factory the moves peculiar to the particular industry, and at home, on the streets, or at recreation imbibing the secret "rules-of-thumb" current among the workmen and known only to them. The very atmosphere seems charged with a mysterious power drawn upon by the men to further the efficiency of their labor, a force which is lost in a city whose industries are largely diversified. The whole accumulation of skill is at the beck of the firm which needs it, and in an industry where trained men are required, its value is beyond estimate.

The greatest resource that the Commonwealth of Massachusetts possesses is her abundant supply of skilled men and women collected in various localities where special work is being performed. The contrast with a state like Pennsylvania is made plain if we suppose some awful catastrophe to sweep away all the people of both states. After such a calamity Pennsylvania would arise again in power, because her coal, her natural gas, her iron, and her agricultural sections—such as Lancaster County, famous for its farms—would bring a new population to work these natural resources; but Massachusetts would be dealt a blow from which she would never recover, because her greatest asset would be wiped out of existence; instead of being a commanding industrial state, she would probably be known only as a summer resort. Skilled labor, then, is the basis for her wealth, and this resource is nursed and conserved by localized industries.

Inasmuch as trade secrets and tricks of manipulation of material are handed down from father to son and from friend to friend, there is a social heredity of skill transmitted from generation to generation. Newcomers are easily absorbed in the all-enveloping trade in its home place, but manufacturers who have attempted to draw away even the most highly trained individuals to act as teachers in another remote city have met with failure after failure because the *group* was not skilled and had not known the trade from childhood. The group skill found in a localized industry is the reason why the industry clings to one small section of the country; it is the greatest single advantage that employers find when they set up their plants where others have thrived for years.

Mobility of Labor

Skilled labor differs radically from unskilled in its mobility. Skilled men and women dislike to be wrenched from the town where they have settled, for it means uprooting a whole life. They have made many social or economic ties that are hard to break; their friends and relatives live in the town, their fathers and mothers perhaps are buried there, they own their homes there, and have small investments in other land or maybe in the industries of the town. Since so many localized industries employ skilled laborers, and inasmuch as the industries are vitally dependent upon that labor, they perforce must stay where the labor has become knitted to the locality. Quite to the contrary, unskilled labor has no deep roots in the soil of a place; their interest is primarily financial—the pay envelope—and not social. Hence unskilled labor may be shifted from town to town with the utmost ease. This helps to explain why industries employing unskilled labor are not localized, while skilled industries are highly concentrated in particular communities.

Home Work

The visible supply of labor at work in the factories is not the only advantage a localized industry offers to mill-owners, for there is a less apparent benefit which grows out of localization, in the ready, rapid expansion of the labor force during rush seasons by means of home work. We talk about our times as the "factory era," yet one-half of the people[1] employed in producing wearing apparel, jewelry, silverware, paper articles, sporting goods, and celluloid ware, are never housed within factory walls, but do the work in their own rooms. In Massachusetts, for illustration, home work is not confined to large cities, to tenements, or to foreigners, nor is it an unofficial pittance to the poverty stricken; on the contrary, the greatest number of home workers have a family income ranging between $750 and $1,500 a year. The tasks are performed largely by women about thirty years old who have formerly been wage-earners, but are now married and tied to their homes by children, yet glad to do little jobs to earn "pin money," perhaps about $100 a year. Manufacturers are delighted to avail themselves of this labor force, for it makes no extra demands on the employers, and yet enables them to get out orders on time. It is their safety valve—or, to use economic terms, the "marginal element in the labor force"—since the factory force may be kept intact while the number of operatives outside the walls swells and contracts with the demand for products.

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[1] Massachusetts Bureau of Statistics, Industrial Home Work in Massachusetts (Labor Bulletin No. 101).

Wherever the nature of the home work necessitates some skill or previous training and at the same time the product is subject to the whims of fashion or to seasonal variations, the manufacturer is well-nigh compelled to locate his plant where the labor lives. We can appreciate why 14 of the 28 comb factories in Leominster, Massachusetts, give out home work; why it is that in jewelry manufacture 74 per cent of all employees are outside the factory roof; why almost all women's neckwear is made in homes; and why even in so thoroughly a mechanical industry as shoemaking, the bows for shoes and the beading for slippers are made and attached in private dwellings. A large amount of home work is also carried on in connection with the collar factories of Troy, New York, and the glove shops of Gloversville, New York. Hence in all localized industries we must add the invisible trained labor force to that which is in plain sight in the factories; the two together form a combination whose advantage no employer can overlook. Yet this is not the only advantage to be found in a community whose energies are devoted to one product; among others are the facilities offered for buying and selling.

Buying and Selling

In a localized industry small concerns may buy together and thus gain the advantage of bulk shipments, a saving which in the course of a year would represent a considerable amount. Freight rates are apt to be lower too, where there are many concerns purchasing the same sort of raw material, because the railroad will equip itself to handle the variety of freight in which its customers deal. By co-operation, the cotton manufacturers of New England have been able to secure such low commodity rates on cotton shipments that whereas formerly much of their raw material was shipped to them by water, it now comes entirely by railroad.

In selling it is easier to dispose of wares in the vicinity of others who are doing the same thing, because a market is established to which prospective buyers come. This is the reason doctors, dentists, and department stores locate where there are other doctors, dentists, and department stores. A new concern cannot afford to forsake the involuntary aid extended by its neighbors in the same business. Together they constitute a center which purchasers seek; separated, each concern would be forced to put forth strenuous efforts to attract buyers to its doors.

Concentrated Market

The creation of a market within a localized industry leads logically to the result that some portion of the community devotes itself more and more exclusively to the marketing side of the business. In England, Manchester is less a cotton-mill town than it is a warehouse city where raw materials are collected for the cotton-mills in nearby Bolton or Oldham, or where the cloth from those mills is sold. Leeds holds a similar position in respect to the iron trade of England. In Massachusetts we see a like tendency in that Boston is the warehouse for the shoe industry on its border, and New Bedford is really three towns under one name, two devoted to manufacture and one to trade. Worcester holds an analogous position for the textile-mills of the Blackstone River Valley, and Providence for the jewelry industry of the Attleboros.

The cause for this striking segregation of the market is twofold; on the one hand it is due to unusual transportation facilities at one part of the district, and upon the other to the increasing rents at a center, driving factories to the rim and leaving the heart to offices which take up little space. These central places too offer advantages for buyers to congregate; aside from railway or hotel accommodations, it is easier for buyers to visit a series of warerooms close together than it is to travel from mill to mill, although the mills may all be in one district. Wherever an industry has become sufficiently developed in one locality to bring forth a central market for buying and selling, the advantages of the localization are greatly increased, since a well-defined place of bargain and sale secures more trade than would a number of scattered offices.

Advantages to Employees

Not all the advantages of localization are on the side of the employers, for the employees too gain by dwelling in a city where there are many factories where men of one trade are employed. For instance, a man who is a cotton-weaver stays where weaving is done in several factories, because if he loses his job in one he may be able to get a place in another. Likewise, immigrants or weavers from other states will seek the town where weaving is a well-known occupation, because they have a chance of obtaining employment at the thing they know best. Consequently in a localized industry there is greater security of jobs for laborers than in a town where there is only one factory of a kind. Furthermore where there are many people engaged in the same tasks, a labor union is much easier to form than in a community boasting only one factory of a particular type, unless that one is exceptionally large. A skilled man or woman fares better in a place where there are many others who possess the same kind of skill, since all can make their demands felt by acting in agreement. Although the organized cotton-mill workers of Fall River constitute but a small fraction of the total number of wage-earners in the industry, nevertheless they set the wages for the whole group in New England; in concerted action there is strength.

Disadvantages of Localization

To both employer and employee, therefore, localization offers many advantages, but it also has deterrent features that detract from the favorable picture we have drawn; there are shadows as well as high lights.

Chief among the disadvantages is the distance separating the industrial center from the consuming market. As we have mentioned before, buyers tend to seek the community in which an industry is localized, but these men represent wholesale houses, jobbers, or large mercantile establishments, most of which of necessity must be far from the town where the goods they purchase are produced; consequently the public to which the wholesale men cater is a long way from the factories. For illustration, products manufactured in New England must be transported often half the length or the breadth of the country before they reach the individuals who actually use them. This long carriage adds to the cost of the articles to such an extent that an effort is made to produce the things needed nearer the point of consumption. It was for this reason that shoe factories were first set up in St. Louis, and the advantage of being near the market has so fostered its growth that it now ranks among the four most important shoe centers in the world.

But for the most part the disadvantage of distance from consumers is easily borne by the localized industries because their products are either small and of light weight, or have such a high value that they can bear long shipment. In every case the labor charge is a large item in the costs of production, so that if a manufacturer must choose between cheap transportation and cheaper labor cost, he unhesitatingly votes for the labor. To locate near the market but away from the recognized center of production, adds greatly to the wage list, for men can be induced to leave home only by the lure of more money in their pay envelope; and furthermore, transplanted factory operatives lose in group efficiency, as we have pointed out. As a result, the distance separating producer and consumer, although a disadvantage, is not the greatest of evils when goods are relatively easy to transport.

Distance from Raw Materials

In like manner, many localized industries are remote from their source of raw material and therefore must face a freight charge upon every unit of stock they use.

Here again the actual amounts to be paid are more startling than are the relative, for the cost of carrying cotton from the South, leather all around the world, steel from Sweden, and rags from Europe, all form so small a portion of the value of the finished article—cloth, shoes, tools, and paper—that the burden on the business is scarcely recognizable. So long as labor represents the largest single item in the total cost of production, localized industries as a whole will not be likely to seek a position nearer raw materials in order to save freight charges.

Labor Unions

From the employer's point of view, the strength of the labor unions in a localized industry is a thing that is abhorrent. Labor organizations are strongest in those industries in which the labor force is most highly skilled and collected in the narrowest area. In the grip of such unions, employers are helpless, and when pinched they wriggle, squirm, and cry out just like any other weak thing in the grasp of power; their only relief is to run away. The unions of Lynn became so dictatorial in the matters of "closed shops," wages, and hours of work, that several shoe firms employing many hands moved outright to Lowell, or Manchester. In these places they have gained a temporary relief, but both towns are becoming shoe centers, so that in the course of time these manufacturers must submit to labor or seek a newer asylum. The power of unions in localized industries, therefore, is a strong force working toward decentralization, at least until unions cover the whole industry over the entire nation; then there would be no escape anywhere and one place would be under the same conditions as another.

Competition

Since competition is most severe where the competitors are closest together, every manufacturer must accept the terms offered by any one of their number, otherwise all buyers would flock to the firm offering the lowest prices. Frequently in a localized industry the whole trade is demoralized by the presence of some beginner who, although skilled in his work, nevertheless is a poor business man because he cannot calculate costs accurately and consequently bids for business by selling his goods below the actual cost of production. Of course he meets ruin eventually or changes his policy, but so long as he maintains his low price level all other manufacturers must sacrifice profits in order to conform to it.

Competition is also made a strenuous struggle by the constant strain for improved processes. No matter how carefully guarded the secret of a new device may be or how securely it may be protected by patents, nevertheless in a localized industry such a secret device soon becomes known and every manufacturer installs it in some more or less modified form, with the result that no man can long enjoy exclusively the fruits of his own inventiveness. The study of processes is a daily grind and the race for improvements is swift indeed, yet the prize is barely attained when its value is snatched away by a new race for a new prize. This situation is highly desirable from a social view-point, for it tends to lower prices and widen consumption, but to the manufacturers who bear the brunt of the contests, it is extremely discouraging.

Hard Times

From the employer's view-point, consequently, a localized industry has these distinct disadvantages: it is remote from its market, it strengthens the arm of labor, and it promotes bitter competition. To the whole population of the district, a localized industry brings another source of dread, particularly if the community has specialized in the industry. To illustrate, Philadelphia is the center where carpet manufacture is localized, but Philadelphia has not specialized in that branch of business. Her industries are widely diversified. On the other hand, Trenton is not only the seat of the pottery industry but the town has specialized in that trade. Little else is manufactured there except pottery. It is that kind of town we have in mind here.

In such a town the fear of hard times is always hovering over the people. To take an illustration: As long as business is prosperous there is hardly a better place in which to live than Attleboro, Massachusetts, for everyone has plenty of money and does not stint the spending; but Attleboro, manufacturing a luxury (jewelry), early feels a fall in the industrial barometer and during a period of financial storm there are few places more hard hit or in which people look more anxiously for a return of better conditions. This is true of every town whose industries are subject to an elastic demand, or are not diversified.

Blight of Uniformity

From the point of view of employees, localization is bad because it tends toward narrowing the minds of the townspeople. A young man brought up in Fall River, say, has but little choice of occupation; he must become a weaver or a loom-fixer, or in some way be connected with cotton manufacture. By upbringing, education, and example he is forced into that path, and furthermore he goes to work at an early age. It may happen that in this way many a life is constricted which might under better conditions have expanded. There is something deadening to the human mind in uniformity; progress comes through variation, therefore in a town of one industry a young man loses the stimulus for self-advancement. In such a town there is little difference in social position, with the result that young people do not have the force of example prodding them to aspire toward heights above their present station. Discontent translated into action may be a blessing in disguise, but in a community where all are equal, contentment with one's lot begets lethargy, because there is no contrast urging towards betterment. This contentment tends toward the creation of a laboring class that is self-perpetuating, a condition inimical to American ideals.

Indifference toward education is one of the results that flows from the creation of a labor class, for a desire for knowledge is one of the characteristics attached to progress, inasmuch as aspiration feeds on inspiration. Lowell containing more than 100,000 people, and Lawrence with nearly that number, each have but one high school.

On the other hand, Springfield, Massachusetts, whose population numbers about the same as Lawrence but whose industries are highly diversified, has no less than three high schools. Worcester also has many unlike industries, and her four high schools are in proportion to the population three times as numerous as Lowell's, for she has one to 36,000 people, while Lowell has one to 106,000. It is a disadvantage, therefore, for a young man to grow up in a community whose industries are all alike. The chances of his getting a well rounded education are slim, as the educational facilities are so limited.

Balance of Advantage

The disadvantages of a localized industry, namely the distance from markets for raw materials and finished goods, the strength of labor unions, the multiplication of plants, the suffering in hard times, and the creation of a labor class, are outweighed by the advantages. The ability to secure the right labor, the ease of selling, and advantages in buying, recommend to an employer the place already established in an industry. On the part of the employees, security of jobs and opportunity for organization among the workers are strong lures toward a center recognized for a particular class of work. Therefore an industry started by a local resource or by accident continues to grow in one spot through the branching of new plants from old ones, through new concerns organized by sons or superintendents, through the advancement that comes by subdivision of product, and through the accumulation of small factories that make use of waste products. Localization is therefore a persistent feature of industry.

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CHAPTER IV

THE UNAPPRECIATED TIN-PEDDLER—HIS SERVICES TO EARLY MANUFACTURERS

Early Connecticut Agriculture

It seems to be a trait of human nature that in the glamor of a big success the small beginnings that made the success possible are forgotten. Some of the great industries of which New England is so justly proud have ceased to remember that they owe their start to the humble and even despised peddler. Because the peddler in his zeal for a bargain often sold hams made of basswood, cheese of white oak, and nutmegs of wood, these are the things on which his reputation rests, and not the real service he rendered to the struggling industries of his day by disposing of their products. The story of the peddler takes us back to early colonial Connecticut.

The first settlers in Connecticut followed the general rule that farming, the getting of a food supply, interests men before any other industry, for, as we have pointed out elsewhere, it is only when agricultural opportunities fail that other modes of earning a living are sought. Connecticut pioneers picked out the rich farm lands along the Connecticut River and in so doing seized the best land available for agriculture. In the rest of the state the soil is thin and full of rocks, so latecomers in Connecticut had to seek some way of gaining a livelihood other than farming. In keeping with the rest of New

England, shipbuilding and fishing became the industries of the shore; distilling rum and molasses the occupation both inland and along the coast. But since these failed to fill the demands for employment, many settlers emigrated westward. It remained for two enterprising immigrants to find a new profitable home industry.

First Yankee Tin-Peddler

Two brothers, William and Edward Pattison, came from Ireland to the settlement of Berlin on the Connecticut River in 1740, and finding no farm lands to their liking set up the business of making tinware, a trade they had learned in England. This industry required little capital or labor and was fitted for pioneer conditions. Its market was good, for tinware had previously been a high-priced, much prized, imported article. The brothers bought their supplies of sheet tin at Boston from cargoes brought from England, carrying it by horseback to the Connecticut River town where it was pounded into shapes for utensils with wooden mallets over anvils. When a goodly supply of wares had been prepared they were packed into a sack, and with this slung from their shoulders the brothers traveled on foot through the near-by settlements, making house-to-house calls until the stock was sold. Thus began the Yankee tin-peddler.

Within a short time the range of the brothers' travels became too great to be covered on foot, so ingenious baskets were fitted to horses' saddles and the peddlers rode about their business. As their trade continued to increase, young apprentices were taught the art of making tin. The brightest, most reckless young men in the home town were sent out on the road with one or the other of the brothers to learn the lures of a trade involving on one side shining tin, and on the other, caraway and mustard seeds, feathers and old metal. These young men became that great institution, the Yankee tin-peddler. They were brave, for no coward would venture alone on long journeys at that time; they were clever, for they had no rules to guide them through the accidents of the road; they were highly immoral, for they were always among strangers and alone; they were keen-witted, for they were pitted daily against sharp pioneers; and they were full of tricks, for they would do anything to make a trade.

Rise of Tinware Industry

Of course the neighbors of the Pattison brothers envied and emulated their success, and soon Connecticut became the recognized center for tinware. Each home shop sent its corps of men to tour the colonies, so the nasal-toned, hawk-beaked, wiry, psalm-singing Yankee peddler was known wherever two or three people were gathered together. When the nation began to build turnpikes in 1790, these roads enlarged the peddler's operations, for they allowed him to use a wagon of his own invention instead of the back of a horse. The wagon was designed to carry the most wares in the least space, and was a maze of secret compartments, hooks, and drawers. With the coming of canals and roads the peddlers perfected their organization.

Single or two-horse wagons were started from Connecticut in the spring, and traveled north, south, and west toward prearranged depots. In the fall, workmen from the Connecticut shops were sent by water to such central points as Montreal, Richmond, Charleston, or Albany. There they made new articles of tin from raw materials which they had carried with them. Peddlers worked toward these central points to replenish their wagons and then struck into the interior for the winter, making house-to-house canvass of their wares. In this way literally every hamlet in the country came to know and use the Yankee notions sold by the peddlers.

Selling Organization

After 1820, roads had been so much improved that depots could be established at favorable inland points, as well as at places reached by waterways, making it possible to extend operations still further inland until even the most remote frontier was reached. Since the currency was in a chaotic state, much of the trading was by simple barter, the peddler taking household products to the towns and town products to the farms, until such times as he could sell for actual money. At the end of a six or eight months' trip the peddler sold his horse and wagon wherever he could do so to his own best advantage, and then made his way back to Connecticut with his gains for his employer. Thus was built a strong distributing and selling organization that closely resembles in some of its details the oil monopoly of today, whose hold is chiefly in distribution and not in production. Most of the peddlers were not individual traders, but were employed by a few capitalist tinmakers in Connecticut. The supply stations were established at strategic points and from these, regular routes ramified in all directions. Thus the whole country was controlled by a complete distributing system.

All this elaborate organization was in the sales department of the business; its manufacture remained a simple thing. A small shop, rarely employing more than fifteen or twenty men and seldom conducted on what we know as the factory system, sufficed to keep several times as many peddlers supplied. Connecticut was the recognized leader in the tin-manufacturing industry down to 1850, but the state does not owe so much to the value of the goods produced or to the number of men employed at home as it does to the perfection of an intricate selling system and the extension of the fame of Connecticut as a manufacturer of useful articles. Tin no longer holds a high place in the manufactures of the state, but other goods which were carried to their market by the organization made to sell tin, and dependent on it for their success, have become permanent, valuable assets for the state.

Connecticut Brass Industry

It will be interesting to trace some of these other industries, particularly the production of brass goods and clocks.

The brass industry had its humble beginning in the manufacture of buttons. The first buttons were made of pewter, and sold for as high as a dollar apiece. Pewter buttons gave way before those made from brass, an alloy made from copper and zinc. The copper for the brass buttons was obtained from old sheathing in the shipyards of Connecticut, Rhode Island, and Massachusetts, or from worn-out copper kettles of the New England rum distilleries. This copper was mixed with imported zinc and made into sheet brass in mills that had cast and rolled iron in the western part of the state before the Revolution. Since there was no market for sheet brass, none of its producers thought of selling it outside of the narrow region around Litchfield and Waterbury, Connecticut, where it was made; but they stamped buttons out of it because these articles did have a ready market and moreover could be easily carried long distances because they had such high value in proportion to their bulk and weight.

Opposition to Home Products

However, in attempting to reach a market, the button-makers struck a snag in the opposition of the regular dealers to handling American-made goods, then held in universal disapproval by merchants. Inasmuch as buttons were made of metal, they were usually sold by hardware dealers, but the dealers refused to have anything to do with American-made buttons, claiming that English buttons were superior in quality and appearance. The infant industry seemed about to meet an untimely death. Shut out of one market, the experimenters reached a better, more direct one, by handing over their buttons to the peddlers. Since the buttons took little room, the peddler could easily add them to his stock-in-trade. Through him they found a ready and increasing sale, for although town-living dealers supplying fashionable, luxury-loving, prejudiced town citizens might deride or ignore the American product, the peddler thrust beyond the towns and catered to country farmers whose tastes were uninfluenced by foreign contacts and whose predilections were all for American products.

Expansion of Industry

Although brass was first made to supply buttons, improvements in casting and rolling brass so increased the supply of the sheet metal that the demands for buttons alone could not utilize the surplus; new uses had to be created. The new products were all small, such as brass kettles and lamps to hang alongside the tin vessels on the peddler's wagon, or wire drawn from the sheet brass and then stamped into pins or hooks and eyes. The peddler was glad to add these things to his outfit, because the greater variety of wares he had to display, the more was he sure of striking a trade.

Between the earlier tin-manufacturing industry and the later brass there were many unlike features. The making of articles from tin always remained a simple, small-scale affair, whereas brass manufactures grew to giant proportions; the tinshops employed but few workers, while the brassmills and factories eventually supplied jobs for thousands of skilled men and women; the Connecticut tin business was short lived, but the brass has been a permanent valuable addition to the state. Nevertheless the great brass industry is greatly indebted to the tin which went before it, for without the distributing organization provided for marketing tin utensils, the first brass buttons upon whose manufacture the modern brass industry was based could have found few buyers.

The Clock Industry

For the manufacturing of clocks too the peddler was the means of reaching the market. In our colonial period, clocks were ponderous affairs made of wood and standing higher than a man. The making of these clocks was one of the ways by which our forefathers eked out the living denied them by the thin pebble- and rock-strewn soil. Some of the Connecticut settlers applied their ingenuity toward making a clock cheap enough to go into the ordinary home, and less of a curiosity or luxury. The first improvement instituted was the making of interchangeable parts, which alone greatly increased the production of clocks and cheapened their cost. Next the clock was made small enough to stand upon a shelf. This advance marked a new era. The small shelf clocks, like buttons and pins, found their market on the peddler's wagon and met with an astonishing sale; no longer were clocks the badges of the rich, for every poor man could own one. Many attempts to replace wood by metal, or even glass, in the clock parts failed because metal was expensive and wood cheap; not until 1837 was brass cheap enough to compete with wood. That year a radical improvement was made. First, the clocks were constructed to run for one day only and not for the customary eight days, and then the interchangeable parts were made of stamped brass, and the price was $6, a figure so astoundingly low that Connecticut became the nation's timekeeper. Peddlers carried the new brass clocks into every nook and cranny of the land, becoming nearly as famous for clocks and as "clock-tinkerers" as they had been for tin. It was this wide sale that gave the industry its start. In the field of luxuries, the peddler carried Connecticut-made silver knives, forks, and spoons after the method of silver-plating on a German silver foundation was discovered. The story of the beginning of the manufacture of builders' hardware, now so highly localized in New Britain and Bristol, Connecticut, would show the same dependence upon the peddler. The peddler was the connecting link between a widespread, scattered demand and a bettered means of production.

Local Tradesman

So in many ways the peddler was the necessary go-between joining producer and consumer. Peddling started at a time when roads were but poorly kept trails, oftentimes missing altogether, so that the lack of a better system of distribution due to this absence of better means of communication enabled peddlers to establish the custom of trading with them. When turnpikes and canals were constructed, they afforded the peddler a better means of getting about and increased his business by extending its range. But when railroads were built the peddler's knell was sounded. The steam engine was quicker, cheaper, and more efficient than the horse, and people preferred trading with a man of their own community when that man could get goods quickly and cheaply by railroad.

The peddler fell from grace. He was no longer a welcome visitor bringing news and wondrous trinkets from the world outside. His former customers went to the local tradesmen, his cart lost its red paint, and his horse no longer looked well kept. Also the type of the man engaged in peddling changed; the shrewd, bareboned Yankee was replaced by the bearded Hebrew or the unctuous Greek. Within a few years after railroads first appeared the jingling tin-cart was seen only in the remote districts far away from the railroads. Today the trolley cars, rural free delivery, and the parcels post are driving the peddler even out of this market; soon he will be but a picturesque memory.

Although we must admit that the peddler deserved his reputation for being oversharp in a bargain, we must not let this fact blind us to the real service he has rendered. When other means were lacking he provided a feasible way of getting goods into the hands of the users of the goods. Production without sale is failure; distribution and consumption are the life of trade. Without the peddler as distributer many of New England's industries would have waited a much longer time to be born, and then conditions would have so changed that New England probably would not be their present home.

New England therefore ought to honor the peddler for his service rather than despise him for the manner in which the service was rendered.

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CHAPTER V

THE IRON AND STEEL INDUSTRY

Predominance of Market

The story of iron and steel in the United States turns about one central theme, the market for the products. As the market has changed, so has the location of the industry shifted, its technique advanced, and its output been given new forms. Raw materials, especially fuel, have had an important bearing upon the manufacture of iron, particularly upon the localization of the primary branch that transmutes ore into pig iron; nevertheless the power of the market has dominated raw materials, and even forced the adoption of new fuels. Consequently the market has been at all times the most influential factor directing the destinies of the iron and steel business.

Each period in the economic history of our country has been set apart by some prevailing interest, and naturally enough an industry so closely allied to every-day activities as iron and steel, reflects the popular concern in its own annals. An account of iron and steel is a miniature of the industrial chronicles of the United States. Thus it comes about that during the colonizing era the market for iron was strictly limited to the locality where the iron was produced, but that later on, when commerce absorbed the attention of the settlements, iron-makers found an outlet among shipbuilders and distillers. After prospering for a hundred years in this market, the masters of forges discovered new claimants for their goods among the first pioneers who pushed westward to form settlements in the valleys that front the Alleghenies. When two wars with Great Britain left America free to develop her own resources, both the industrial expansion of the East and the agricultural advancement of the lands west of the Alleghenies provided an admirable stimulus to melters and fabricators of iron. But it was not until the railroads came into prominence in the years succeeding 1830 that the really great markets for iron were discovered. No equally important outlet for iron wares has been brought to light until recently when shipbuilding and foreign trade once again claimed the interest both of the nation and of iron-workers. Local uses, maritime needs, frontier necessities, factory and farm equipment, railway construction and outfitting, shipbuilding and foreign trade—these have been the markets that have determined the economic history of iron and steel.

Early Local Forges

No colonial farm or village had a great need for iron products, and even what little they did use could be dispensed with in times of stress or places of scarcity. Log cabins were often made without nails by crossing the logs one over the other and allowing the ends to project. More elaborate cabins were held together by fitting the logs into each other by means of notches. Sometimes, too, beams were held in place by rawhide thongs. The Mission at Monterey, California, was built in this manner, as may be seen even to this day. Nevertheless a small quantity of iron was everywhere desirable for nails, pots, kettles, or tools. Accordingly, after permanent settlements had been made upon the Atlantic coast there was not a colony, except Georgia—the last colony settled, and one that was never prosperous till after the Revolutionary War—that did not establish forges for itself.

The reasons for these forges are not difficult to perceive. In the first place, iron was relatively expensive to import; its bulk or weight was great in proportion to value, and the danger of injury was ever present, particularly in the case of brittle cast articles such as pots or kettles. It was estimated that because of the cost of transportation, the distance from Great Britain to the colonies gave the American iron-makers the equivalent of a 25 per cent protective duty. In the colonies themselves, the same factor—difficult transportation—kept the industry local; overland carriage was impossible and coastwise traffic impracticable because of the weight or brittleness of iron. Furthermore, no center could get news of small orders from remote villages until long after the need had passed. Finally there was no common medium of exchange because metal money was so scarce that each locality transacted its business by barter or by a local currency, a condition inimical to free and easy exchange of products between distant colonies. As a result of these conditions, no one place was so advantageously situated that it could manufacture the iron for all other communities. On the contrary, all the factors tended to encourage supplying each local market from a local source; in fact the assemblies of Virginia (1662) and Massachusetts (1637) helped to keep their iron industry local by forbidding the export of iron.

The three important raw materials—ore, fuel, and lime—were easy to obtain. There was not a colony in which iron ore did not exist in some usable form. As for fuel, there was a superabundance since charcoal was employed for that purpose. Lime, which served as a flux—uniting with the impurities of the ore and so helping to remove them, and which also aids in melting the ore—was widely distributed and existed in many varieties ranging from common limestone to oyster shells. Consequently the three important raw materials—ore, fuel, and flux—were easy to obtain; with them present it was a simple matter to reduce ore to metal because the business could be done on a small scale with elementary apparatus. Indeed, most early iron-making equipment comprised nothing more elaborate than small forges, hand-bellows, anvils, and hammers. Each community possessed iron facilities as part of its necessary equipment just as sawmills gristmills, and fullers' shops were found everywhere.

Nail Industry

In addition to supplying farmers and townsmen with pots, kettles, and tools, there was always a demand for a large amount of bar iron to be slit into nails. Before the Revolution all nails were made by hand and consequently they were always scarce. Since it required no training to hammer out nails from bar iron, it was customary for farmers to spend their idle time in the winter at this occupation, and in many homes it was an evening job throughout the whole year. Tacks were made in the same way, and as a result nails or tacks frequently took the place of money or agricultural produce when the farmer went to the nearest village store to barter. In 1790 when Jacob Perkins of Massachusetts invented a slitting and heading machine that reduced the cost of nail-making to one-third that of the household product, he began the elimination of the little forges by the hearthstones. Between 1790 and 1800, for example, there were 23 patents granted for nail-making machines and by

1825 the total was 120. This is a measure of the importance of nails to young growing settlements. In 1810 nail rods comprised 25 per cent of the total output of iron. Nevertheless nail rods were sold at stores in the remote back country of the South until quite recent years, and tack manufacture continued as a household industry until 1830.

Massachusetts as Leader

Despite the enormous modern development of the iron and steel industry, local forges have continued in existence down to our own times. These are usually in the byways of the country, such as the Kentucky mountains, far removed from active contact with the world outside, remaining in use by the countryside because of its inaccessibility, the same factor that gave rise to the original small local forges. A few are nearer civilization and are known as "high-water forges," that is, they operate only when iron is so high priced that their relatively high cost of production may be met. For example, Louisville, Kentucky, in its petition for the government armor plate plant in 1917 urged the advantage of its city in possessing near-by a string of these "high-water" furnaces that would offset any possible shortage in pig iron. In the main, however, the strictly local iron business was confined to colonial times. Even then, despite the wide diffusion of iron-making, one colony, Massachusetts, soon surpassed all the others by a generous margin and led the country in production for over a hundred years. Iron was first discovered in North Carolina, by Sir Walter Raleigh's ill-fated settlement at Roanoke Islands, in 1585. It was first manufactured in Virginia by the Jamestown colony of 1607. That Massachusetts should hold the primary position, points to the importance of a market, for Massachusetts alone of all the colonies presented a considerable outlet for iron goods.

The Bay Colony differed markedly from the others along the Atlantic coast in that it had no agricultural products to offer abroad in exchange for goods. (See Chapter II, page 30.) Without hope of winning distinction in cultivating rocky, steeply pitched fields, the people of the northeast early turned their backs upon the land and looked to the sea for sustenance; from it by fishing, shipbuilding, and commerce they gained distinction and fortune. Since it is almost an axiom that no industry can become great without giving rise to contributory enterprises, it was but natural that the extensive maritime business in its turn provided a large market for iron.

Maritime Demand

Iron entered into marine outfitting in many ways, the most obvious of course being the nails that held ships together. As has been shown, this was largely a household industry but many furnaces were necessary to furnish the bar iron. As a consequence, the first successful furnace established at Lynn in 1645 was followed by another at Braintree in 1646, and in a short time Boston was ringed round with iron-making establishments. It was in Massachusetts where the largest market existed that nail-making machines first became common, and they were in general use there by 1795. An iron casting that every vessel possessed was the ship bell, for a bell was as much a component of a boat as its rudder or its anchor. The latter was still another of the iron castings needed to complete a ship's gear. Each vessel required at least two and inasmuch as fishing was done from small boats, each dory had to have its own small anchor. The manufacture of bells or anchors consequently was a business of no small value. Since no sea was safe from marauders, and pirates lurked off the mouth of every river, and each merchantman was the prize sought by numerous freebooters, even the smallest trading vessels carried an extremely heavy armament for protection or for aggression if opportunity arose. Not only were these cannon the product of American works, but the balls too were supplied by our furnaces and forges.

Other Sources of Demand

Shot and guns, bells, anchors, and nails, all necessities arising from fishing and shipbuilding, were supplied by the iron-makers of Massachusetts. The prosperity of fishing and commerce was reflected in the growth of iron manufacture, but commerce bolstered the iron industry still further by bringing to Massachusetts raw materials that, in the process of refining, called for iron utensils.

Chief among these imported crude products were sugar and molasses. In response to abundant raw materials and a market greater than the production, sugar-refining and rum manufacture flourished all along the shores of Massachusetts Bay. Rum, at that time, was an especially valuable product, in great demand. Inasmuch as the more southern colonies, notably Pennsylvania, turned surplus grain crops into beer and had no raw material for rum, the distilled spirit was an important article for commerce between the Atlantic colonies. The settlements upon Massachusetts Bay and near-by Narragansett Bay became the centers for distilling because they surrounded the principal molasses-importing towns, Boston, Salem, Newport, and Providence. The distilleries concentrated upon such a small area constituted a market for iron ware by reason of the fact that the pipes, kettles, and stills were made from iron or copper. Likewise, the kettles for purifying crude sugar were of iron material.

Barrels for cargoes of molasses, rum, fish, and sailors' food supplies were held together with wooden or iron bands; indeed in 1795 one-half of the output of iron was devoted to this purpose. The traffic in fish gave rise to the subsidiary industry of deriving salt from sea water by evaporation, a home job all along the shore of Massachusetts Bay and upon Cape Cod. This practice required large iron drying-pans. Hence iron manufacture was not only stimulated directly by fishing and commerce, but also indirectly. Boats were held together by iron nails, navigated with the aid of iron bells, made secure by iron anchors, or protected by iron cannon that fired iron shot. The very cargoes carried by the ships were held in iron bands and rendered useful by iron utensils. Inasmuch as the largest direct and indirect markets for iron were connected with the fishing and commerce of Massachusetts, and furthermore since these deep sea callings were most popular and most profitable in Massachusetts, it is natural that this colony should lead in the manufacture of iron. Where the market was, there also was iron made.

Market the Determining Factor

That the market was the principal agent influencing iron production in Massachusetts may be made clearer by a hasty survey of other possible factors. Fuel can be dismissed at once, for when Massachusetts was famous for iron (1650-1750), wood was everywhere abundant. Flux is usually easy of access where iron is produced, but eastern Massachusetts was lacking in lime-bearing stones and the iron-makers had recourse to marine shells to supply the deficiency. This was no hardship, it may be remarked, for oyster shells cost about 12 cents per ton of iron, whereas the limestone charge ran very much higher, ranging from 62 cents to $1.68 per ton of iron.

Eastern Massachusetts had no high-grade iron, although it was endowed with a poor variety known as bog ore, yielding from 25 to 50 per cent of iron. As its name indicates, this ore was found in swamps or at the bottom of ponds, precipitated from the water by minute animals, *infusoria gaillonella ferruginea.* It lay from one-half to two feet deep, so a man in a boat working diligently with grappling irons or tongs could gather two tons in a day. Moreover, as the iron may be deposited as long as the minute animals remain alive, a new "crop" formed again in the same pond after an interval of twenty years. Thus one constricted area with a number of large ore-bearing ponds could keep a small-scale furnace in continuous operation. For example, a pond at Middleboro, Massachusetts, yielded 300 to 600 tons of ore a year for over 60 years. Despite the numerous deposits of this ore in eastern Massachusetts, the demands of the industry outran the supply of raw material with the result that Massachusetts' furnaces were supported by ore from New Jersey, Pennsylvania, and Maryland, and the refiners of iron imported rough bars from Russia. In addition, home-coming trading vessels often carried scrap iron or ore to Massachusetts as ballast. Therefore, the industry was not any more dependent upon local ore than it was upon fuel or flux; the market was the dominant influence.

Westward Progress

This situation was unchanged until about 1750, when settlements began to appear in valleys removed from the coast. In these was repeated the history of the older eastern communities; local iron making at first supplied the newest local markets but eventually well-recognized centers were established.

The valleys chosen by these first American pioneers were those that cut across the foothills of the Alleghenies, the Connecticut, Housatonic, Mohawk, Lehigh, Shenandoah, Cumberland, and Tennessee. These valleys constituted almost a continuous highway from Alabama to Canada. Now, while it was comparatively easy to travel north or south along these pathways, journeys westward were blocked by the Alleghenies or eastward by innumerable hills, especially in New England. As a consequence the new clearings were forced to be self-sustaining, for their wants could not be fulfilled by the established settlements that bordered the Atlantic. Among the pioneers in these valleys, therefore, a new market for iron goods arose that necessarily was dependent upon local production. Furthermore the articles demanded by the frontiersman were entirely different from those needed in shipbuilding and called for specialized iron manufacture.

Frontier Demand

These settlers had a small but vital use for iron because life, sustenance, and home depended upon a few iron tools. Foremost among those was the pioneer's gun, without which he would not dream of venturing forth. Protection in a wilderness full of enemies, sustenance in a land where food must be shot, clothing on a frontier where looms, fullers, and tailors were absent—all these wants were satisfied by a gun.

Next to his firearms the pioneer valued his axes, for with these he made his home and his barns, hewed his roadways, and gathered his fuel. With no other tools than a gun and an ax, a man might live in security and comfort; nevertheless, most pioneers added shovels, hoes, scythes, as well as pots and kettles to their equipment.

Potash

Of the kettles there were two varieties that were usually important, one for potash and the other for sugar. Potash—literally the ashes of wood, burned in pots—was valued highly in the world's commerce because wood was scarce in the old countries while potash was prized for fertilizer or for the manufacture of soap and many other articles. The American frontiersman found potash a most desirable commodity upon which to spend his spare time, for the trees that supplied the raw material encumbered his land, while the finished product brought a good price and moreover could be easily transported for long distances. Frequently the potash was further refined at the farm and sold as pearlash. There were so few things that a pioneer could sell or exchange for necessities, that this almost ideal riddance of rubbish for a respectable remuneration could by no means be overlooked.

The kettles or pots in which the wood to be used for potash-making was burned were very large, frequently weighing as much as a thousand pounds, and taxed the ironmaker's resources to the utmost. Since every frontiersman from Vermont to Alabama required at least one such kettle, the forge masters were given no little work. Similar kettles were necessary for reducing maple sap to syrup or sugar. Unless he was willing to do without sweetening, every settler beyond the reach of the cane sugar refineries on the coast was forced to go into the forest every spring and gather his year's supply from maple sap. This common practice again reacted upon iron-makers, for the kettles were many while the number of iron-makers was few, and even the best furnace men could not turn out iron for more than four such kettles a week.

Supply of Materials

The valley settlements therefore called for firearms, edged tools, simple agricultural implements, and household utensils—all made from iron. Fortunately the materials to supply this demand were at hand in the valleys themselves.

The entire length of the valleys from north to south was underlain by limestone, and veins of iron abounded from Canada to Alabama. Rock ore and lime, two of the essentials for an iron industry, were therefore present where they were most needed, and the third requisite, wood for charcoal fuel, was of course ample in amount. As a result, wherever a small community appeared, a forge or furnace was almost certain to follow. These supplied local needs by local production from local materials.

Here, however, a further resemblance to the seaboard iron industry must be noted. It will be remembered that it too was a local industry in each colony, but that iron-making arose to prominence in the one that offered the most extensive market. Likewise in the interior valleys, two places from which there was easiest access to markets became the leaders in frontier iron manufacture. These two selected communities were Salisbury, Connecticut, and Lancaster, Pennsylvania.

Iron Mines of Salisbury

Near Salisbury, in 1732, on land granted to Yale College by the colony, ore was discovered. Two years later when the college disposed of its hundred acres, development of the iron deposits commenced and they have been mined ever since. Their greatest importance, however, was in the hundred years after the middle of the eighteenth century. Following 1750, they soon rose to prominence and no less than 30 furnaces surrounded Salisbury within a circle of 30 miles. By 1800 there were 50 bloomery forges in Litchfield County, Connecticut, in which Salisbury is located, not to mention many others near-by in Massachusetts and New York.

Salisbury iron was highly esteemed for two reasons: one, the unusual quality of the iron; the other, the ease by which it could be carried to market. The ore yielded a metal which was equaled in only one other locality—the Juniata Valley of Pennsylvania—and was particularly adapted to the manufacture of firearms or edge tools. It stood as high as the best Swedish iron or even English mild steel. Furthermore, the ore deposits were so located that they commanded the routes north or south along the Connecticut, Housatonic, Mohawk, and Hudson river valleys. Water carriage was absolutely essential for the existence of any iron works that were situated beyond a few miles of land haul from the consuming market. In 1783 the cost of transporting one ton of freight by land from Albany to Fort George, a distance of 65 miles, was $32, or 49 cents a ton-mile. On the other hand, a ton could be carried from New York City to Canada by way of the Hudson and Lake Champlain for $55, or about 12 cents a ton-mile. Hence a heavy commodity, such as iron, could be conveyed only a short distance by the expensive overland methods, but might travel four times as far by water. That helps to explain why Salisbury iron could enter New York City, 75 miles away, and why Lancaster, Pennsylvania, products within 70 miles of Philadelphia were seldom seen in that city, although they were commonly sold in Baltimore, more than twice as far away but reached by the Susquehanna River. Besides its high-grade ore and access to markets, Salisbury was surrounded by limestone and the encompassing Berkshire Hills were covered with forests. The natural consequence of this combination of advantages was the high standing of Salisbury in the early iron trade.

Great Valley Industry

Just as the Connecticut village stood at a point where the chief northern water highways could be reached readily, so also Lancaster, Pennsylvania, held a corresponding strategic position upon the routes toward the south and southwest. The main artery of land travel extended from Philadelphia to Lancaster where one branch ran into the Great Valley southward, while a second turned westward by way of Harrisburg and the Juniata River. Lancaster too was the metropolis for a wide agricultural valley splendidly endowed with fertile limestone soils. In 1777 Congress sat at Lancaster for a few days and from 1779 to 1812 this city was the capital of the State. In short, it was the largest and most important inland city in the country throughout the first quarter of the nineteenth century. Here, then, was an admirable market for iron where settlers bound for the South or West could equip themselves at the place nearest to their future homes. The farmers of the county looked to the city for tools and utensils, and the needs of the city itself created a demand for iron goods. The natural means for supplying this market were at hand, for the whole of Lancaster County and its neighbor, Chester County, are dotted with deposits of iron and the entire area is underlain with limestone. The presence of ore, flux, and forests for fuel, removed every obstacle to an iron industry once a market was assured. Lancaster therefore became the center of an iron-producing region that claimed 17 furnaces in 1786, and fifty years later boasted over 100, at which time it ranked among the principal iron-makers in the entire country.

Separation of Smelting and Rolling

After Salisbury and Lancaster had become firmly established in iron-making, a curious situation arose, appearing then markedly for the first time but repeated often in the subsequent history of iron; the smelting of iron from ore was separated from the manufacture of the pig iron into finished products.

It happens that the primary and secondary stages of iron manufacture are not equally affected by the same set of economic factors. The reduction of ore to metal often occurs where the raw materials are found, for although it is highly desirable that pig iron be manufactured near its market, it is not absolutely essential, and of course it is more economic to transport pig iron than ore, if a choice must be made between one or the other. On the other hand, rolling-mills and foundries that work pig iron into a great variety of forms are little dependent upon close proximity to their raw material—the pig iron—because pig iron is easily handled in bulk and is valuable enough to stand fairly long shipments. Rolling-mills however must necessarily be near their market, for finished iron articles are bulky, heavy, hard to handle, and relatively expensive to transport. Thus it comes about that furnaces and mills are often widely separated and that mills are found where there is no local ore, fuel, or flux. After 1750 the disappearance of both bog ore and forests from eastern Massachusetts caused the rolling-mills to secure pig iron from the Salisbury district to the west, where ore and fuel were plentiful. In like manner, Lancaster supplied the foundries and rolling-mills of England with pig iron, shipping it by way of the Susquehanna River and the port of Baltimore.

Gun-Making

Although the expansion of the United States and the opening of new distant markets has brought about a relative and absolute decline in the importance of the Great Valley furnaces, yet in rather curious ways they have left their impress upon modern industrial life. To protect her own foundries and mills, England, in 1750, prohibited the colonies from fabricating iron, an order which was well obeyed on the Atlantic coast where English officers were numerous and the population relatively dense, but in the remote and isolated Great Valley the law was ignored and iron manufacture carried on clandestinely.

Guns were the chief product for the reason that they had a ready sale, a high value, and were easily carried or hidden. So numerous were the gun-makers in the hills along the Great Valley that the Continental Congress called them together at Springfield, Massachusetts, and at Harpers Ferry, Virginia, to manufacture arms for the government. These two places were the seats of the first United States arsenals, established respectively in 1778 and 1794. From Springfield, gun-making spread southward into Connecticut where the great factories at Hartford (Colt), New Haven (Winchester), and Bridgeport (Remington), are the direct descendants. Furthermore the admirable quality of Salisbury iron gave rise to numerous edge tool works in the Housatonic, Naugatuck, and Connecticut River valleys where the edge tool business of the United States is now centered. Consequently the iron industry of the Great Valley is not without its present significance, although the iron produced there is of little consequence.

Crossing the Alleghenies

Until the Revolutionary War the American frontier was bounded by the Allegheny Mountains. At that time there was plenty of room in the East. At the opening of the war the population was only 3,000,000 in the thirteen colonies. Beyond the mountains, too, were the hunting grounds of the Indians under the sway of France, then a rival of Britain. Trans-Allegheny settlements were discountenanced by England because new villages called for protection—an onerous burden—and also interfered with the existing profitable fur trade. Such villages, furthermore, offered no market for English goods because of the expense of transportation.

When the war closed, however, the great western migration began. Men who were pioneers by inclination, soldiers who had become infected with the roving spirit by their army service, farmers whose lands were encumbered with taxes and debt or who were discouraged by the low prices prevailing for agricultural products—in short, all those who were disappointed in the East—sought the West with high hopes for better fortune. They were joined by immigrants from foreign shores and the whole stream poured into what is now Ohio, Indiana, and Illinois.

Since every settler needed tools and utensils, this great transfer of people opened a new region for the production and disposal of iron wares. The mountains barred eastern iron-makers from the western market, so the pioneers were compelled to establish their own works to fill their own needs. This trans-Allegheny industry possessed two characteristic features: it was set up where travel routes gave direct access to the market, and it comprised foundry and rolling-mill enterprises rather than furnaces.

Cincinnati

The favorite route to the West started at Philadelphia, advanced to Lancaster and Harrisburg, climbed the mountains to Pittsburgh, and then continued down the Ohio River to Cincinnati. There, trails into the interior of Ohio, Indiana, Kentucky, and Tennessee crossed the river highway. At Cincinnati roads north, east, south, and west converged to a point; it was the common meeting place for the whole great interior between the Alleghenies and the Mississippi. As a consequence it played the rôle formerly in a smaller way assigned to Lancaster. For fifty years Cincinnati proudly held title to the largest inland city in America and boasted that eventually it would be the greatest city in the world. The boast might possibly have been realized if the railroad had not become a factor. The difference between Cincinnati and Chicago, for example, is the difference between river and rail transportation.

So far as reaching the market was concerned, Cincinnati was therefore the ideal situation for a new seat of iron manufacture, and as a matter of fact a promising business did start there. Furnaces using local ore were erected across the Ohio River in Kentucky and others were built in Ohio itself, but all of these undertakings suffered from lack of ore. The furnace activities eventually centered about Hanging Rock and Ironton, 150 miles above the river metropolis. The second stage of iron manufacture, represented by foundries and rolling-mills, also appeared in Cincinnati and shortly became one of the leading activities of the place. They very effectually reduced the price of iron to western consumers. For example, bar iron that sold in 1814 to 1818 for $200 a ton was $110 a ton in 1831, and castings that were as high as $130 a ton in 1814 to 1818 could be purchased for $60 a ton thirteen years later. In 1859 it was estimated that 50,000 people were directly or indirectly supported by the iron works. But Cincinnati has always remained true to her tradition, seldom producing primary iron but specializing in the manufacture of tools, utensils, and stoves. It is noteworthy that all of these articles are most economically produced near their market, either because convenience is a factor of importance or on account of the expense of transportation.

Pittsburgh

Next to Cincinnati the best location for an iron industry was Pittsburgh. Until the Civil War, the story of Pittsburgh resembled that of Cincinnati. An attempt was made to smelt iron at Pittsburgh in 1792, but this was abandoned within two years due to lack of ore. No further effort to erect blast furnaces took place; in fact Pittsburgh produced no pig iron and possessed no blast furnaces until 1859, just before the opening of the Civil War. Instead, rolling-mills absorbed all the attention of the Smoky City's iron masters, the first mill appearing in 1812 and followed soon afterward by others. As early as 1829 there was one plant capable of turning out 100 plows a day. The market is strongly reflected in this item, for at that time the grain belt was confined to Ohio, Indiana, Illinois, Kentucky, and Tennessee, all easily reached from Pittsburgh by way of the Ohio River. The demand of a frontier market is also apparent in Pittsburgh's other iron products; boiler iron for the river steamboats; hoop iron for pork and whisky barrels, or ties for cotton bales; stove iron; and ax, hoe, or shovel blanks.

As has been said, Pittsburgh itself had no ore, but in the upper reaches of the Monongahela River, from the very town of Connellsville 50 miles southeast of Pittsburgh, which now furnishes coke that is the world's standard, ore was mined and reduced in local furnaces and shipped to Pittsburgh. This business became great enough to mark the region as one of the principal iron-producing areas west of the Allegheny Mountains, a position it held until 1850 when Lake Superior ore began to displace that from the Monongahela. But Pittsburgh reached further than the Fayette County furnaces, for the Juniata River district east of the Alleghenies, famous for the quality of its product, was called upon to furnish bar iron and blooms for Pittsburgh's rolling-mills. The high value of the Juniata iron enabled it to stand the expense of the rough journey over the mountains to Pittsburgh. The customary method of transportation was to bend the bars of iron into the shape of an inverted U and put them over the backs of horses. These traveled in pack trains of fifteen, each horse carrying 200 pounds. The whole cavalcade was under the guidance of two men. When the Pennsylvania Canal was completed, the Juniata iron went by water to Pittsburgh. Despite the hardships and expense of carriage, by far the greater part of Juniata iron was sold to the Pittsburgh mills. The Cambria Iron Company started at Johnstown, Pennsylvania, when that town was the head of navigation of the western division of the Pennsylvania Canal.

Thus the service performed by Salisbury iron for the East, was rendered by Juniata iron for the West; it took the place of modern steel in tools, such as picks, axes, hoes, and some shovels.

Notwithstanding the lack of ore in the immediate neighborhood, both Pittsburgh and Cincinnati rose to prominence in the iron business, but due to that lack both limited their activities to iron rolling or casting. Each city supplied such articles as an agricultural frontier region most needed. The Ohio and Pennsylvania furnaces, including those in Connellsville itself which supported the rolling-mills of Cincinnati and Pittsburgh, relied upon charcoal for fuel. Hence, in the case of these two cities up to the time of the Civil War, the controlling factor in their iron history was clearly their advantageous location in respect to near-by markets.

Growth in the East

Meanwhile the iron industry had been expanding in the older East to such an extent that despite the growing importance of the western furnaces and mills the principal production of iron remained in the East where the population was greatest and the demand largest and most varied. It is a truism that the bid for any commodity is a demand for iron, for even if the article itself is fashioned from some other material, it requires iron in some stage of its manufacture. Hence the rise of the textile industry in the East called for iron, for although the frames of the early machines were wood, many of the parts were iron. For example, the cards or combs by means of which the textile fibers were straightened and caused to lie parallel, were made from iron wire. This wire industry started in the heart of the textile area and it increased to such an extent that by 1860, Worcester, Massachusetts, manufactured 58 per cent of the wire made in the United States.

As the textile industry developed and advanced towards large-scale production, iron replaced wood in the machines, so the growth of cotton and wool manufactures was accompanied by an increase in foundries and machine-shops. These in turn pressed the iron manufacturers for more pig and bar iron. In like manner the mania for internal improvements, such as turnpikes or canals, sent its pulse back to the fires that smelted iron. These improvements called for iron in the construction of coaches or boats, and even the horses that towed the boats were shod with iron. The largest water wheel in the United States was built at Troy, New York, to run three rolling-mills that turned out iron shoes for the horses of the Erie Canal. In short, every step toward the subjugation of the physical environment, every movement toward a more rounded civilization, tended to enhance the importance of iron manufacture. Inasmuch as the East was the manufacturing, commercial, political and social center of the new nation, it was there that the need for iron was most keen. Consequently the greatest amount of iron was produced in the East.

Mechanical Improvements

To meet the requirements of the market both in the West and along the Atlantic coast, technical improvements in iron-making apparatus were required. The old forges in which ore was piled upon an open, charcoal-filled hearth fanned by a gentle cold current of air squeezed from a hand-operated Catalan bellows was inadequate and was gradually changed to a better device. In 1750 water power was applied to strengthen the force of the draft and wooden bellows took the place of the Catalan. The better draft permitted a higher furnace, and this turned out more product. The Lynn furnace of 1645, one of the best of its time either in America or England, had an output of 8 tons a week. In 1788 the progress with draft and taller stacks permitted a production of 15½ tons a week. The next step was taken in England in 1784 when Cort invented the puddling furnace and the grooved roll. Previous to this time all iron was purified by hammering with sledges over and over again. Cort's puddling furnace took pig iron upon a shallow saucer-like hearth where the iron melted. It was then stirred until nearly all impurities were removed. When ready, the iron was carried to the second invention—the grooved rolls—and there was twisted, turned, and squeezed until it was pure enough to use. The resultant iron was fibrous and tough and therefore fitted for all purposes where strength was a desirable quality. All other needs were met by melting pig iron and pouring it into moulds. The final measure, taken before 1830, to insure a supply of iron was a Scotch invention whereby the draft was heated before its entrance to the furnace, thus saving fuel and at the same time raising the temperature of the furnace. The Americans seized the new ideas and brought their product up to 35 tons a week.

Railroad Consumption

By 1830 the iron industry had attained this stage of mechanical perfection adjusted to the needs of consumers. While it is true that the industrial expansion of the East was reflected in the progress of iron manufacture, nevertheless by comparison with later events, the earlier iron trade was a small affair. The one factor of all others that has placed the iron industry of America before all competitors in the world is the railroad. Railroads have been the greatest consumers of iron within the history of that commodity. To build and equip the railways of the United States has taxed the iron industry to the utmost; it has enforced changes in location, the adoption of new fuels and ores, and an almost unbelievable advance in technique. Yet the full effect of the changes wrought was not felt until the Civil War.

Railroads did not immediately influence the iron industry, because iron at first formed so small a part of a railroad's equipment. The frames of locomotives, the coaches, and even some rails, were all made of wood. Iron entered into railway construction and rolling stock only as wheels, axles, springs, and the small parts of the engine. All the producing centers—Massachusetts, Connecticut, New York, and Pennsylvania—contributed a share of these necessities. Gradually iron replaced wood in locomotive frames and iron straps fastened to wood or stone contituted the rails. Parts of the New York Central retained these rails until 1850, and in the South they were familiar even ten years later. Loose straps were a frequent cause of accident, for they rammed through the floors of the fragile wooden cars, maimed or killed the passengers, and often ditched the whole train. Solid iron rails were adopted to remedy the evil, but none were manufactured in this country until 1844.

It may be seen how ill prepared our iron manufacturers were to recognize the market that railroads constituted when it is stated that the Philadelphia and Reading Railroad in 1844 advertised for months for 8,300 tons of T rails without getting a single American iron master to bid on them and was forced finally to import the rails from England. This was two years after the importation of rails duty-free had been remedied by a tariff. However, in the same year, 1844, a mill was erected in Maryland for the express purpose of rolling heavy iron rails, and was followed the next year by another new mill at Danville, Pennsylvania. These two mills may be said to have inaugurated the modern expansion of the iron industry in response to the railroad influence.

Shortage of Supply

In 1830 there were 23 miles of railway in the United States, but during the next ten years nearly 3,000 miles (2,810) were laid down. All of this activity was confined to the Atlantic coast with Philadelphia as the principal radial center. Between 1840 and 1850 no less than 6,000 miles of trackage was built, for the most part in New England. These facts had an important bearing on the iron industry, for they stimulated the American makers to feverish activity. Despite larger furnaces and improved processes, production lagged far behind demand, and the first railways were largely equipped from foreign sources. In 1850, 60 per cent of America's iron consumption was imported. Not only the railways themselves, but all the manufacturing enterprises that the new transportation agent encouraged, put a greater and greater strain upon our iron industry. In its headlong effort to keep abreast of its market, furnaces were enlarged, new fuels tried out, and a new region chosen as a manufacturing center where both raw materials and markets were within easy reach.

Anthracite Furnaces

So long as furnaces were small, charcoal was the most desirable fuel because it made the purest iron, but a large furnace required so much fuel that the surrounding wood was soon exhausted. It required 250 to 360 bushels of charcoal to produce a ton of iron. Thus, if all the iron of 1850, for example, had been produced by charcoal, it would have consumed 46,000 acres of forest. On the other hand, 200 acres of four-foot coal could do the same work. A moderate-sized furnace necessitated a wood reserve of 4 square miles, while to carry charcoal from a distance added prohibitively to the cost of production. Since the little 15- and 20-foot furnaces of 1830 were utterly inadequate to produce the iron needed by railways and factories, the height went to 25, 30, and 45 feet, with a diameter of 12 feet. With increasing height, the scramble for fuel became even more vigorous until the need for a substitute for charcoal was imperative.

Soft coal generally was not strong enough to bear the burden of the ore, although in Ohio a furnace 55 feet high and 16 feet in diameter, produced 1,600 tons of iron a month with raw bituminous fuel. Distilled soft coal in the form of coke was then unknown in the United States. There remained but one other available substitute for charcoal, namely anthracite, which had been used in a minor way in connection with iron rolling since 1812. After much disappointing experimenting it was at last successfully employed for smelting iron. In 1840, before the rolling of iron rails began, there were only six anthracite furnaces in all the United States, but by 1856 there were 121, and for twenty years thereafter (1855-1875) anthracite was regarded as the principal iron smelting fuel.

Eastern Pennsylvania

As everyone knows, the anthracite fields are in eastern Pennsylvania about equidistant from Philadelphia and New York and in a region where iron ore was plentiful. Connected to the seaboard by canals and railroads, the area was admirably situated to support an iron industry, because it had both the requisite raw materials and access to the greatest market. In the ten years following 1850, the New York Central extended its lines to Buffalo by way of Albany, the Erie Railroad connected New York City with Lake Erie at Dunkirk, the Baltimore and Ohio reached the Ohio River, and the Pennsylvania joined Pittsburgh to Philadelphia. Here was a circle of railway-building around the anthracite coal fields that helped to push railway mileage from 9,020 miles in 1850, to 30,626 miles within the next ten years. It is easy to see, therefore, why the Schuylkill Valley, the Lehigh Valley, the Susquehanna, and the Juniata were the seats of the iron industry of that period. The following towns of the region became famous for iron manufacture: Reading, Harrisburg, Phoenixville, Steelton, South Bethlehem, Danville, Pottstown, and Lebanon. They have retained their fame to the present day.

Prodigious Growth

The real development of railways, however, did not begin until after 1860. Since the railroads normally consume one-third to one-half of all the iron output, the great growth of iron manufacture also did not come until after the Civil War. Since that time American railways and American iron and steel have multiplied themselves so prodigiously that even the bald figures measuring the growth are well-nigh incredible. In 1860 there were 52,000 miles of track. Thirty years later we had 163,597 miles, including no less than three transcontinental lines. The mileage laid down between 1880 and 1890—70,000—equaled the total building in the three leading European countries in fifty years, and in 1914 more than one-third of the entire railroad mileage of the world was in the United States. This astounding record is reflected in the tonnage output of our iron furnaces. In 1860 the average run of a furnace was 35 tons of pig iron per day. By 1900 the American furnaces were pouring out 1,000 tons as each day's work—a thirty-fold increase in forty years. In 1917 the Bethlehem Steel Company pushed this figure to 47,000 tons a month. Nowhere else and in no other industry have these records been equaled. Consequently it is no surprise that the progress has been accompanied by marked changes in the location of the iron industry, the materials with which it works, the products which it sells, and the organization by which such great results have been accomplished.

The Western Market

As we have stated, the principal market for iron before 1860 had been in the East, for it was there that railways were first built, where factories prospered, and where the bulk of the population dwelt. After the war, railways pushed on beyond the Mississippi and became transcontinental in scope. In 1869 the first line was laid down and in 1880 three others were built. Not only these far-western roads were constructed, but the Middle West was filled with feeding and connecting lines within its territory. In Ohio, Indiana, Illinois, Iowa, and Missouri, railroad after railroad was constructed until this area had the densest railway net in the whole country.

To supply the materials for the construction and equipment of the railways expanding with such amazing rapidity, staggered the already burdened iron industry. The influence of the railroads upon iron production, however, was by no means limited to the necessities of the roads themselves, for every other industry whose activity was increased by the railroads augmented the demand of iron.

Farm Implements

For example, railroads made it possible to market wheat, corn, oats, and rye raised in the territory beyond the Mississippi, but it was impossible to plant, cultivate, and harvest great grain crops without the aid of machinery. Hence railroads indirectly stimulated the manufacture of labor-saving mechanism for use on farms, and each new device led to the adoption of another. Thus after 1855 reapers were sold as fast as they could be manufactured, and by permitting the harvesting of larger areas induced the adoption of more rapid threshing and cleaning machines. When these were obtained, seeders and cultivators were a necessary sequence, and so the chase went merrily onward, one mechanism prompting another. In 1830, 34 agricultural machines were patented; in 1831 the number was 38; in 1861, no less than 350 patents were issued; and in 1863, when machines took the place of war-drafted men, the number had advanced to 502.

The adoption of all this agricultural machinery meant a demand for iron and ever more iron. Each great farm using reapers, binders, and the like at the same time increased the existing demand for the simpler tools of farming such as hand-rakes, hoes, or shovels, and where wood was scarce wire fences were run along boundary lines to set pastures off from fields and to separate one man's holdings from his neighbors.

Universal Demand

New wagons required iron; horseshoes were iron; roofing was often of iron; pails, nails, hinges, locks, latches, and countless other articles could be traced to an origin in a blast furnace. Consequently railroads added enormously to the market for iron, not only for their own equipment but also for the equipment of the farms the railroads served.

Even this does not tell the whole story, for nearly everything that a farmer in Kansas bought from the East, whether the article itself were iron or not, increased the sale of iron. A call for more clothes in the West was translated into a demand for more factories and more machinery in the East, both factories and machines requiring iron for their construction. Every house that was built, every town that became a city, every water wheel that turned, every steam engine that labored, every book that was written or read, every meal that was prepared, nearly every activity of every man sooner or later was dependent on iron. If the modern world should be deprived of iron suddenly, our whole civilization would crash about our ears into a heap of dust.

Furnace Capacity

With such a market, the iron industry strained under the pressure put upon it and sought to adjust itself to the fast increasing needs. Greater output was the immediate, prime necessity, and under this lash startling advances were made in mechanism. Furnaces that were 45 feet high in 1859 were replaced by 75-foot stacks in 1872, whereat the world stood agape; but even these were not adequate, for by the time the century closed furnaces 110 feet high had been erected. The 35 tons a day output of 1860 was pushd to 50 tons ten years later.

Within five years this figure was doubled and another five years saw it doubled again. By 1890 the daily output was 300 tons and since the opening of the twentieth century the astounding amount of 1,500 tons a day has been reached!

Coke

The larger furnaces magnified the difficulties inherent in anthracite as a fuel. Among these were its wastefulness of draft, and its crushing or matting under heavy loads of ore, thus limiting the height of furnaces. The air in anthracite furnaces was under a pressure of 7 to 10 pounds. The Lucy furnace of Pittsburgh using coke in 1870, had a draft of 8 to 9 pounds, but whereas the anthracite furnaces were 55 feet high and produced 200 to 300 tons a week, the Lucy furnace was 75 feet high and turned out 600 tons a week. Other difficulties of anthracite were its comparatively high percentage of noncombustible, non-heating elements, its lack of uniformity, and its increasing price. A careful search was instituted for a more ideal fuel and after investigation, experiment, and failure, at last success was attained with coke, the carbon residue of bituminous coal that has been heated without combustion, and whose volatile gases have been eliminated. Coke had been known in England since 1740, at which time English charcoal was almost exhausted, but its adoption in the United States had been long delayed by the ample supply of charcoal or anthracite. In 1849 there was not one coke oven operating in all Pennsylvania, and even seven years later the state claimed but 21, while there was less than 100 in the whole United States.

The first commercial development of the well-known Connellsville coke, which is the best in the world, carrying as high as 70 per cent fixed carbon and less than 1 per cent of injurious sulphur or phosphorus, began in 1841, when it was sold in Cincinnati to stove-manufacturers and other iron-refiners, but coke of any kind was not popular. In 1855 the Baltimore and Ohio Railroad was completed to Pittsburgh and carried coke to that city where it was used successfully in the rolling-mills. The real development of Connellsville coke, however, did not begin until 1860 when it was used for smelting iron. With the adoption of Connellsville coke the fuel problem for the increasingly large blast furnaces was solved, for Connellsville coke burns easily, is strong enough to bear the burden of ore, has great heat, and adds no impurities of its own to the iron. From 1860 onward coke began to displace anthracite and by 1875 had taken the lead as an iron smelting fuel, a position it has held from that time to this.

Lake Superior Ore

Larger furnaces and better fuel called for a greater amount of high-grade ore than was being worked when the expansion of the market began. The ores near the existing blast furnaces were either largely exhausted or of low grade. The most satisfactory ores obtainable were discovered near Lake Superior in the states of Wisconsin and Minnesota. A blast furnace in Mercer County, Pennsylvania, imported 70 tons of this ore via Erie, Pennsylvania, in 1853 and the excellence of the ore attracted the attention of iron masters all over the state. The Sault Canal was opened in 1855 and regular shipments of Superior ore began the next year.

Aside from its high quality, the new ore commended itself to iron-makers because it was so easy to mine. It lies near the surface and is so soft that it can be lifted by steam shovels, a fact which means that enormous quantities could be removed at small labor cost. More dirt has been removed, it may be remarked, in laying bare the Lake Superior deposits than was dug to make the Panama Canal. One shovel with the labor of eight men on the Mesaba Range has mined and loaded in ten hours 5,800 tons; in a month the record was 164,000 tons. In 1900, three machines working during the day shift lifted into cars 915,000 tons of ore. Whereas on the Mesaba Range, these machines take 5 tons at each grab, filling a car in two and a half minutes and moving 600 tons in an hour, on Massachusetts ponds a century earlier one man in a boat working with osyster tongs was fortunate to collect 2 tons of ore for a full day's labor. Two tons a day against 600 tons an hour, gives a measure of the difference between the market for iron in 1800 and that of a hundred years later, for the amount of ore mined by modern methods in one hour would have lasted a colonial furnace for a whole year.

The Hearth of the Nation

The quantitative mining of the high-grade Lake Superior ore and the shift from anthracite to coke that accompanied the increased size of furnaces could not well avoid bringing about a change in the localization of the industry, since the new ore and new fuel were not found near the established furnaces. Hence the greater furnaces that arose to utilize the new materials were set up in new centers more strategically located. The place that was most admirably adapted to reap all the advantages of the changed conditions was Pittsburgh.

Pittsburgh lay half-way between the extremes of the eastern and western market; it had excellent rail connections eastward and both rail and water routes to the west and south, and since after 1860 the principal railway construction was in the states immediately west of the city, Pittsburgh was nearer to the point of greatest consumption than the older centers to the east. Moreover Pittsburgh was next door to the best coke in the world; Lake Superior ore could reach it easily and cheaply; it had a long-established rolling-mill industry—in 1856 there were 25 rolling mills in Pittsburgh and Allegheny—and lastly it was already organized to market iron products. Inasmuch as no other place possessed such a combination of attractions, Pittsburgh became the hearth of the nation, and from 1859 onward no American community has been so thoroughly identified with all parts of the iron industry as the city that stands at the head of the Ohio River.

Cry for Better Iron

The same force that brought Pittsburgh into the ranks of pig iron producers, namely the technical progress necessitated by an enlarged market, put this new center into the forefront of the industry because the later mechanical advancements were most intimately associated with Pittsburgh itself. At first the cry had been merely for *more* iron, but as locomotives became larger and complicated, as trains were longer and heavier, as buildings were higher and machinery more important, the wail was for *better* iron as well as larger quantities of it. Bridges made of wood or iron sagged and broke under the weight of the increased load; iron rails snapped and spread under the pound and thrust of heavier, faster locomotives and the burden of larger cars. In other fields, too, progress was manifesting itself in a demand for better iron; for example, increased business called for higher buildings in cities, but stone and brick structures could not tower in the air without making the lower stories almost solid, which of course was impractical since the street floors of most buildings were the most valuable. Iron supports for stone and brick were of slight value because they buckled, so architects and builders too prayed for a stronger material. From railways, factories, and cities everywhere the cry arose for a better grade of iron.

Steel

Steel fulfilled the universal craving. Steel differs from iron in the proportion and accuracy of mixture of the elements of which it is composed. Iron from which no carbon has been eliminated is brittle and cannot be hammered. It is called "cast iron." Pure iron without any carbon at all is known as "wrought iron." Steel lies between these two extremes. Its exact definition is difficult, but if iron contains less than one-fiftieth of carbon it is usually called "steel." The carbon content, however, varies over wide limits according to the use made of the steel. Special steels also contain other elements, such as nickel, manganese, chromium, tungsten, or vanadium.

Steel was as well known to iron-makers as iron itself and had been manufactured in small quantities since the dawn of history. It had been used, however, only for the finest and most costly articles, such as high-grade cutlery, because it was so expensive to manufacture. The purest charcoal fuel and the most selected ore were necessary for the pig iron that made steel. The pig iron was hammered into bars and these packed into boxes between layers of charcoal and brought slowly to a high heat in a retort that resembled a lime-burner. After weeks of watching and testing the bars were removed, having been transformed from iron to steel through the absorption of carbon from the charcoal. The risk of failure in this process was high and even at best the product was never uniform; a standard material for cutlery, for instance, was only to be obtained by carefully sorting the steel bars, combining and rolling together the proper ones, and then re-sorting and recombining. Obviously steel so laboriously, lengthily, and expensively produced could not be made into rails, bridges, or skyscrapers; one might as well use diamonds for curbstones. The world needed abundant cheap steel; how to get it was the problem.

Bessemer Process

The riddle was solved in England by Sir Henry Bessemer. He poured fifteen tons of molten pig iron into a movable pear-shaped retort and then blew hot air through the mass for about twenty minutes. The air combined with the carbon in the pig iron and passed out of the iron and the retort in the form of flames, spitting, sparking, and roaring from the mouth of the vessel. When all the carbon was gone, a definite measured amount was restored to the iron. When the melted mass was poured into moulds it was no longer iron but steel, stronger than iron and almost as cheap.

This process of steel-making gave the world what it wanted; steel made in thirty minutes not three months, steel little more expensive than iron, steel many times stronger than iron. But the United States had to wait eight years before it could use this great industrial boon; lawsuits stood in the path of progress. In 1856 when Bessemer tried to patent his process in the United States he found that a William Kelly had made an independent discovery of the same idea and that Kelly claimed priority, a claim that was sustained. Although Kelly obtained his patent monopoly he was never successful in producing steel, because his machine seemingly was not as good as Bessemer's. An essential part of the Bessemer-Kelly process was the addition of a known quantity of carbon to the purified pig iron and this step was controlled by patents issued to Robert Mushet, the originator of the method. The Kelly group obtained the monopoly of this step in the United States, so for some time matters stood at a draw. Some Troy, New York, men who controlled the Bessemer interests in the United States could not operate without infringing upon the Kelly right to the use of spiegeleisen. This is a name given to good cast iron containing a known quantity of carbon and a small amount of manganese, the latter helping to eliminate any sulphur that may be present. On the other hand, Kelly could not produce steel because his machine was not as good as Bessemer's and he could not improve his machine without infringing the Bessemer patents. Naturally the two contestants were forced to consolidate, the event occuring in 1866. Fees and royalties were reduced in consequence and America began a belated use of the much-sought steel.

The popularity of the new steel was great and its application rapidly extended until steel supplanted iron for most of the important uses. The price fell from $106 a ton to $17. In 1875 the Bessemer output was 375,517 tons of which 290,863 tons were for rails. In 1860 the rails alone were 954,400 tons and in 1902 had reached 3,000,000 tons. Springs, car axles, plow shares, stove pipe, and a horde of other things were made from steel. A faint conception of the value of Bessemer's contribution may be gained from the statement that one Bessemer rail would outwear twenty iron ones. The age of steel in American industry was not one that first sprawled and crawled, but from the beginning it strode with full vigor.

Open Hearth

After twenty-five years in the use of Bessemer steel had gone by, progress in the market caused Bessemer steel to be as severely criticized as iron had been in 1855. The same complaints were heard arising from similar sources; Bessemer steel was too weak for the work it had to do and was giving way under burdens it was forced to carry. Again the market cried for a better material, and again it was forthcoming.

Bessemer steel is manufactured in half an hour, hence it is cheap, but that very inexpensiveness is purchased at the price of accuracy and definiteness in the proportioning of the iron and carbon that determine the steel. An iron master can never guarantee the content of his Bessemer steel. Fortunately there is another kind of steel known as "open-hearth," manufactured by a slower and more costly method that produces a high-grade product and one that can be warranted. This steel is manufactured much as a good cook makes soup, for it is tested in a chemical laboratory while making, just as a cook dips out a spoonful of soup to taste its flavor. Although it takes from six to eight hours to produce open-hearth steel, its content is known with absolute certainty. In addition, greater quantities can be made at once—50 to 100 tons instead of 15 as in a Bessemer converter—and a wider range of materials and products is possible.

Open-hearth steel was manufactured in the United States as early as Bessemer, but due to its greater cost and higher quality, it did not compete in the same market with Bessemer. By 1897 however railroads and structural engineers found that they must use a better steel than Bessemer, so they turned to open-hearth. Between 1899 and 1904 the amount of open-hearth steel used for rails surpassed that made by the Bessemer process, and never again can the United States go back to the cheaper material. Indeed the Bessemer process is now often but one step in the production of open-hearth, for by combining the two methods the time necessary for the production of open-hearth is decreased a third and necessarily the cost is lowered.

Early Individual Plants

The last half of the nineteenth century therefore witnessed rapid changes in the iron and steel industry; not only were there new enlarged furnaces, new ores, and new fuel, but there were also two new products, Bessemer and open-hearth steel. These changes were accompanied by changes in organization, for a great wide market induced large-scale production and this in turn paved the way for integration.

The same groups of men that owned rolling-mills in 1860 engaged ten years later in pig iron production, but under different corporate organizations. Likewise, a community of interest but not a physical connection, still later existed between fuel- and ore-producers on the one hand, and iron-makers on the other. When these separate corporations first started, they had many a desperate struggle to survive, not because a market was lacking but because it expanded at such a prodigious pace that the many necessary extensions of plants caused the capital of the promoters to assume fixed forms. Consequently it was an advantage to keep each unit individualized despite the fact that all the units belonged to the same persons, for as separate organizations, the units could create capital for each other by issuing notes that might be discounted at banks. For example, a furnace company, a rolling-mill, and a bridge plant might all belong to the same set of shareholders but the rolling-mill could issue notes to the furnace company and the bridge plant to the rolling-mill; the notes discounted for cash were so many additions to working capital. This method of keeping each other afloat would be denied to the three corporations if they amalgamated as one complete unit, because a firm cannot discount its own notes without some other indorsements.

Integration

Twenty years after the Civil War, the iron industry had become firmly enough established to eliminate the use of credit in the manner just indicated. As soon as capital was more fluid, the inefficiency of keeping apart related plants became apparent; the intercompany profits and royalties were sources of annoyance and where plants were controlled by a few interested persons holding a majority of the stock, injustices to minority stockholders caused trouble. Therefore the various parts of the iron industry commenced to coalesce; rolling-mills absorbed furnace companies and amalgamated with fuel-producers. After a start in this direction, its economy and the consequent control of the market it afforded promoted further integration, so steel companies reached out for ore fields and then sought ownership of the transportation agencies.

When all the various stages of production from mining of the ore to finished rails, beams, or plates were unified under one authority, there followed an attempt to bring into the combine even the most important secondary producers, such as wire mills, tube factories, and the like. This, in brief, has been the history of the Carnegie companies, the United States Steel Corporation, and, to a less degree, that of smaller aggregations. Big integrated corporations were a response to national and international markets. An entrepreneur might cope with the simplicity of a narrow market, but a solidly entrenched corporation was a necessity where broad, complex markets were concerned. It is probably a fact that a great corporation like the United States Steel is as truly an evolution as that a national state grows from city principalities.

By-Product Coke

Besides its influence upon organization, the national character of the market has had another effect upon the steel industry; it tends to lessen the supremacy of Pittsburgh. When this city arose to prominence the most traveled routes east and west and southwest passed through its borders; moreover Pittsburgh had almost a monopoly upon the best coke known. Coke cannot usually be shipped great distances because rough handling causes it to break into small pieces. Nevertheless Connellsville coke has been transported 600 miles to Chicago blast furnaces and 750 miles to St. Louis. These facts together with the inertia of industry—that is, its tendency to remain in the region where it starts—maintained Pittsburgh's leadership. The personal element enters into Pittsburgh's primacy, too, because it was Carnegie's home town. The fame of Pittsburgh is largely associated with Carnegie and it is hard to say how great Pittsburgh would have become if fate had willed that Carnegie spend his boyhood, say, in the city of Toledo.

Today the situation is somewhat altered. The main trade routes no longer pass through Pittsburgh, the iron industry has broken from the shackles of Connellsville coke, and economic factors have been known to vanquish inertia. The Great Lakes and the railways along their shores are the highways of inland commerce; by-product coke, made from ordinary soft coal in a closed oven that saves the valuable gases, has commenced to replace Connellsville coke manufactured in a wasteful manner; and low freight rates have been secured for westbound coal in ore cars and boats that otherwise would be empty. All these factors have set up new conditions by which Pittsburgh is put at a disadvantage.

Great Lake Centers

Under the new circumstances Chicago becomes one of the most ideal places for manufacturing iron and steel, and as a fact the greatest steel plant in the world is near that city, at Gary, Indiana. Chicago is one of the greatest railway centers in the world, so not only the roads themselves but all the territory they serve are tributary to Chicago steelmills. But not these facts alone explain the rise of the Chicago district. In or near the city are the country's greatest plants for the manufacture of agricultural machinery; moreover Chicago is a large shipyard for lake steamers and also great wire and pipe plants are within sight, almost, of the city's steelmills. Chicago too is not far from the center of population. Until 1840 the center of population was between Baltimore and Clarksburgh, West Virginia. During that time, Lancaster, Pennsylvania, was an important iron center. From 1850 to 1890 the center of population was along the Ohio River from Parkersburg, West Virginia, to Cincinnati, Ohio; and Pittsburgh was supreme in iron.

Since 1890 the center of population has been in south central Indiana. Is it an accident that also since that date the largest iron plant in the world has been erected in north central Indiana at Gary? But Chicago, unlike Pittsburgh in the preceding era, has no monopoly upon the advantages outlined, so iron works may be found from one end of the lakes to the other, at Duluth, at Sault Ste. Marie, at Cleveland, and at Buffalo. Even Carnegie, despite his personal interest in Pittsburgh, saw the economy of lakeside plants and planned to erect a monster-sized one at Conneaut, Ohio.

Alabama Field

For the market of the South, Birmingham, Alabama, occupies a position similar to Chicago, with the unparalleled advantage of ore, coal, and limestone deposits lying beside each other. Birmingham does not confine itself to southern markets alone, but reaches northward up the Mississippi and Ohio rivers, Cincinnati and Louisville being the meeting points for Chicago and Birmingham iron. Alabama iron and steel goes also by water to Philadelphia and New York. As a result of the growth of these new centers better adapted to reach a national market, the lead of Pittsburgh has been materially reduced, even at the time when that city was pouring out more iron and steel than ever before in her history. Pittsburgh has about reached the limit of physical expansion. Steel works use large amounts of water, hence they always locate near an adequate supply, the banks of rivers usually being the choice. But Pittsburgh has no more level land along the river where present plants may expand or new ones locate. Hence the physical cramping at Pittsburgh adds force to the economic motives for the removal of steel plants to a more favorable location.

In contrast, the lake shores around Chicago offer miles of unoccupied ground sold at the price of waste land, while Pittsburgh extensions are made at the cost of city lots.

Atlantic Seaboard Plants

Another movement that threatens the supremacy of Pittsburgh is the development of a new market upon the Atlantic seaboard, where the iron industry first appeared. The United States has entered upon another period of shipbuilding, this time utilizing iron and steel plates rather than wood. In response to this market, steel plants are being erected upon New York harbor, in New Jersey, and along the Delaware River below Philadelphia. In addition to shipyards, another economic force tending to pull the iron and steel industry toward the sea is the possibility of an export trade. This influence was just commencing to be felt before the Great War of 1914; it undoubtedly will have a marked effect when peace once more settles upon the nations.

The coast industry, like the lake, does not attempt to buy Connellsville coke, but manufactures its own right at hand. The great and little eastern cities offer an admirable market for the by-products of coke-making. Furthermore, some of the iron-makers avoid the long railroad journey for American ore by purchasing their supplies from Cuba, Spain, or Sweden, and taking advantage of cheap transport by water. The works at Sparrows Point, Maryland, and even as far inland as Steelton, near Harrisburg, Pennsylvania, are examples of plants that have established this practice. We have, then, a maritime steel industry foreshadowed that depends upon the presence of no raw material whatsoever; all ore, coal, and limestone must be brought to it. Its seaboard position, however, enables it to assemble all these materials cheaply, while its access to the markets is unexcelled.

Completion of the Cycle

The story of iron and steel, therefore, closes where it began. It was first important upon the coast because there the first market of any account was to be found. As the development of the country caused the market to retreat inland, it was followed by producing plants, and as the market in its expansion enforced improvements in technique, these, in turn, determined the location of the industry. But the growth of a national market and releases from technical bonds broke the monopoly of special areas and spread the industry to places where the market could best be reached. Finally new markets upon the border of the ocean have brought the industry back to the regions where it started. Consequently markets have always been the dominant forces directing the iron and steel business of our country.

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CHAPTER VI

THE COTTON-MANUFACTURING INDUSTRY

Origin

China has always been noted for her silk, Egypt for her linen, and Greece and Rome for their wool, but for the first home of cotton we must go to India. Before men recorded history the people of India were spinning cotton yarn so fine that when made into cloth it was most aptly called "woven wind." India's storehouse was opened to Europe in 1631 when the British East India Company first bought high-grade calico at Calcutta and shipped it to England. The craze for this novel cloth named from the port of its purchase threatened the cherished wool industry of England to such an extent that Parliament passed laws in 1666, 1700, and 1720 aimed to protect the wool trade and to demolish the upstart cotton. But even the wool-weavers centered at Manchester, descendants of the Flemish artisans driven out of Flanders by the persecutions of the Duke of Alva, forsook their wool for the new cotton and surreptitiously copying the Indian calico placed it upon sale in the English market. The cloth was not entirely cotton, as the warp was linen or wool, but this action marked the beginning of English cotton manufacture.

In America too we owe the impulse for cotton goods to India. When England prohibited the use of calico at home she permitted it to be sold and worn in the American colonies, and inasmuch as light cotton cloth was better suited to our climate than England's, the law worked no great hardship; so Indian calico became popular here and paved the way for our own cotton manufacture. After the Revolutionary War cotton cloth was no novelty to us when our mills were ready to produce it.

Inventions

Meanwhile, due to a series of remarkable inventions, England had made giant strides in manufacturing. Between 1725 and 1760 spinners were turning out more yarn than the weavers could put into cloth, because both were hand-operations and spinning was the simpler of the two; but in 1733 John Kay invented a flying shuttle which so greatly hastened weaving that the spinners fell behind in the supply of yarn. Before long, however, the deficit was made good. The spinning jenny patented June 22, 1770, by Hargreave, gave larger amounts of yarn; the water frame patented July 3, 1769, by Arkwright, gave strong warp yarn; the mule, perfected in 1779 by Crompton, gave fine yarn. These inventions put the spinners so far superior to weavers that the latter were again lagging far behind in the race for production until the need for a better loom was met by Cartwright with his power loom, patented April 4, 1785. The factory was brought into existence when machines become too ponderous for man-power or horse-power to turn, and so were harnessed to water wheels and steam engines. Watt's steam engine was applied to cotton-mill work in 1784 at Papplewick.

After all these improvements, pressure was put upon the raw material because the old hand method of separating seed from lint was utterly inadequate to supply the voracious spinning and weaving machines of England. Whitney's cotton-gin filled the breach, coming into use in 1793. In fifty years then, from 1740 to 1793, the cotton industry, from raw material to finished cloth, was put completely upon a mechanical basis, overturning the established household hand-work and substituting mills equipped with machines.

British Prohibition

At the close of our War of Independence, in common with all other nations outside England, we wanted a share in the new industry. Our interest was all the keener by the feeling that having cut our political fetters we ought also to establish our economic freedom. But England refused to sell us any of her new machines and prohibited the exportation of parts, plans, or skilled artisans. She had a good thing and was justified in attempting to keep it. At Beverly and Bridgewater, Massachusetts, Statesburg, South Carolina, and Philadelphia, Pennsylvania, Americans tried to equal the British inventions, but the results were crude and impracticable. The publicity attached to these attempts, however, attracted the attention of a young Englishman named Samuel Slater, a man who had been especially trained in the new systems of cotton manufacture. In response to an advertisement of a prize offered in Philadelphia for information concerning English cotton machinery, Slater left England secretly and went to Philadelphia, hoping to start there the American business.

Philadelphia Conservatism

With characteristic caution in regard to untried enterprises, Philadelphia turned a cold eye upon Slater's demonstrations, thereby losing the opportunity to head the American cotton industry. Philadelphia would have been an ideal place for cotton manufacture to take root.

Germantown, then a suburb of Philadelphia, had long been famous for its stocking-knitters, and the neighborhood was full of German or Dutch spinners and weavers. Furthermore Philadelphia was not far from cotton fields of that period, for the plant had been introduced from the West Indies to the lower peninsula of Maryland and Virginia—the "Eastern Shore"—and had spread from there to the western shore and thence southward. So far as power was concerned the dozens of small creeks that flowed into the Schuylkill and Delaware rivers would have furnished an abundance. Philadelphia itself was one of the four chief commercial centers and so was within touch of the whole American market; in addition the city possessed the damp climate so favorable to all textile manufacture. If cotton manufacture had once started in Philadelphia, it is entirely probable that its leadership would never have been seriously disputed elsewhere in America, for when the mills outgrew the power capacities of the local creeks the admirable situation in respect to coal would have fastened the industry securely to the city. Such, however, has not been the case, because the conservatism that met Slater turned him from Philadelphia first to New York and then to Pawtucket, Rhode Island.

New England

Among those who had experimented with cotton machinery previous to Slater's arrival was Moses Brown, a merchant and importer of Indian cotton cloth at Providence. Under his auspices, Slater went to Rhode Island and at Pawtucket in 1790 established the first successful cotton-mill in America. Between these dates and 1814, Slater's influence was supreme; he and his relatives started many of the early mills and all other factories were built and operated by men trained under him. Providence was the early center for all this activity, and by 1800 Slater's mill was surrounded by 29 others. Ten years later there were 62 mills in New England with 25 additional in construction.

Since New England's inaptitude for agriculture caused her people to welcome any other mode of livlihood, cotton manufacture promising a method of gain divorced from the soil was hailed as an exceptional opportunity. The need for some livelihood other than farming was aggravated in Massachusetts, by an inheritance law that required all heirs to share equally. The result was a large number of small farms whose owners were forced to eke out a living with by-industries.

As to labor, New England was peculiarly fortunate, for along the coast the towns were full of sailors' widows, wives, and orphans, while inland the daughters of farmers tied to the drudgery of their rocky hill homes were glad to escape to the factories where an independent income was assured. The trading boats that plied between Salem, Boston, or Providence, on the one hand, and the West Indies or the east coast of South America on the other, brought to New England cargoes of raw cotton in exchange for fish. None of the earliest American mills were supplied by American-grown cotton because the direct trade was between the South and England. There was a better market in Liverpool for Savannah cotton than in Providence, and the freight rates were relatively lower. As a consequence New England's raw material came over the path of her commerce, from the West Indies. Finally New England's wealth of water power sites and the dampness of the climate in the maritime towns, together with the capital accumulated in trade, furnished the remaining requisites for cotton manufacture. These facts explain why Slater's example was so quickly and generally imitated, and why New England from the first has led in cotton manufacture.

Early Trials

Nevertheless during the first twenty-four years of its history our cotton-manufacturing industry was quite primitive. The story is told that at Southbridge, Massachusetts, a manufacturer employed a lusty negro to turn the wheels of a mill when the stream ran dry in the summer. Power requirements so small as this did not necessitate large streams; therefore a mill could be erected wherever a brook flowed. Cotton manufacture, a business about which the owners knew very little, was added as a minor part of some other enterprise, or started on trial along with other industrial experiments. There are records of mills whose four walls at different times housed the manufacture of flour, shingles, wool cloth, cotton cloth, augers, bits, gimlets, axes, matches, spokes, shoe lasts, mattresses, pails, shoe nails, and candle wicks. Many an early venture in cotton-manufacturing went down under fire, flood, or financial failure with only a gaunt, naked waterwheel on a broken raceway to mark the scene of the former activity.

Although not all experiments ended so disastrously, nevertheless even successful mills produced a poor grade of cloth. No. 14 yarn was the standard grade and none higher than No. 20 was turned out, whereas modern New Bedford mills spin up to No. 140 and modern English mills claim to have produced, experimentally, yarn as fine as No. 650. The first mills, too, were for spinning only; weaving remained as a hand process conducted within homes. In 1820 two-thirds of the textiles used in the United States were made in homes. Cotton manufacture then did not immediately spring into prominence but went through a quarter of a century of trial; perhaps it would have disappeared gradually if it had not been for a series of fortunate incidents occurring close together. The political events between 1807 and 1814 established cotton-manufacturing in America and opened a new era in the industry.

The War of 1812

As has been said elsewhere, interference with foreign trade usually operates as a direct stimulus to domestic manufactures. The Embargo and Non-Intercourse Acts of 1807 and 1809 together with the War of 1812, cut off traffic between Europe and the United States in cotton cloth. At the same time outbound raw cotton was held in our ports, and falling back upon the domestic market lowered the price of raw material. Since our people clamored to be clothed, New England hastened to meet the need by setting up more factories. The very acts that killed commerce were instrumental in furnishing capital to new manufacturing projects, for the money made idle by ship embargo was invested in mills. The only economic limitation upon the expansion of the cotton industry was the lack of a power loom. In 1814 this deficiency was made good by Francis Cabot Lowell, a Boston merchant interested in cotton manufacture. His opening of the first complete spinning- and weaving-mill at Waltham, in 1814, marks the beginning of an epoch.

City of Lowell

The new age was distinguished by two features—the need for water power and the demand for capital. Before 1815 there were few mills that operated as many as 500 spindles, but machinery was so rapidly improved that by 1825 the average New England factory contained at least 700 spindles and one had over 5,000. Before 1840 a Lowell mill was running 38,000 spindles, and by 1860 the number was 76,000. Obviously the small streams adequate for the early mills were utterly unable to furnish power for the newer plants; therefore the industry began to concentrate upon the greater streams. The Boston Manufacturing Company, the corporation that had inaugurated the era at Waltham, found as early as 1820 that the Charles River was too small to keep pace with the headlong advance in manufacturing equipment. The company therefore bought a valuable site along the Merrimac River in 1821 and out of the woods created the town of Lowell. The mill wheels began to turn in the fall of 1823.

The rapid rise of the city of Lowell was the marvel of the times and today reads like the romance of some of our western cities. In 1836 the town was made a city and within twenty-five years became the largest place in Massachusetts except Boston. Today it has a population of 112,000 which makes it rank among the fifty largest cities of America and twenty-fourth in the average number of wage-earners. Land value took a corresponding sky-rocket path. Kirk Boot, the original purchaser of the site of Lowell, bought 90 per cent of a farm of 110 acres at the rate of $17 an acre, but his plans became known before he could secure the remainder, and he was forced to pay $362 an acre for 7½ per cent of the original farm and $2,222 per acre for the remaining 2½ per cent. In 1850 there were 33 mills along the power canals at Lowell and this city was the principal cotton-manufacturing center of the United States.

Other Centers

But five years before this time the power available at Lowell had failed to expand with the ever increasing needs of the business, so the men who had first established Lowell went further down the Merrimac River and selected the site for another town they called Lawrence. This community repeated the history of Lowell—lawless as a mining camp for two years, an incorporated town at the end of that period in 1847, and a city six years later. Holyoke on the Connecticut River was established about the same time as Lawrence. Meanwhile, the best power sites upon the lesser streams were becoming the seats of smaller Lowells. Among these cities were Springfield, Hadley Falls, and Webster in Massachusetts; Manchester and Nashua in New Hampshire; Norwich and Willimantic in Connecticut; Biddeford, Lewiston, and Saco in Maine; and Woonsocket in Rhode Island. The ever growing cotton-manufacturing industry called contantly for greater increments of power; since Lowell, Lawrence, Holyoke, and "smaller Lowells" furnished this requisite, they became the leaders in cotton manufacture. The necessity for water power then was one of the principal features of the new age inaugurated in 1814 at Waltham.

Capital Needs

A second equally important characteristic of the industry was its capitalistic nature. A venture in cotton-making did not consist simply of buying machinery, but involved the construction of whole towns, including houses, stores, and churches, in addition to the mills, dams, canals, and raceways. Whereas before 1813 anyone with a few hundred dollars could start a cotton factory, in the later years only the wealthiest man could afford the experiment and generally even the capitalists were forced to combine their funds into joint stock companies in order to have enough to finance the project. At Lowell, in 1839, ten companies had a combined capitalization of $9,000,000, none of which had less than $500,000, as is shown in the following table.

Remember, too, that this was in 1839 when capital was scarce and high priced in the United States.

CAPITAL INVESTED AT LOWELL—1839

Name of Company	Capital
Locks and Canal Company	$ 600,000
Merrimack Company	2,000,000
Hamilton Company	1,000,000
Appleton Company	500,000
Lowell Company	500,000
Suffolk Company	600,000
Trement Company	600,000
Lawrence Company	1,500,000
Middlesex Company	500,000
Boot Cotton Mills Company	1,200,000
Miscellaneous	300,000
Total	$9,300,000

Rapid Improvements

Beside the huge capital needed for the original investment a generous portion had to be allotted to improvements and betterments, especially in machinery. Since the average length of service of labor in the mills was only four and a half years, no reliance could be placed upon the accumulated skill of the working force. On the contrary, each manufacturer was faced with the necessity of teaching a constant succession of "green help." Inasmuch as there was no dependence upon labor, employers were forced to become inventors and transfer skill to the machines. The immense output of cotton goods rewarded the smallest improvement. The introduction of better methods met with no opposition from labor as in England, because in the United States machines neither deprived anyone of a living nor upset long-established trades. In 1831 the ratio of spindles to employees was 22 to 1; in 1880 this had become 62 to 1, and in 1914 80 to 1. The rapid rise of this ratio at various intervals since 1831 is indicated in the following table:

RATIO OF SPINDLES TO EMPLOYEES
IN COTTON MANUFACTURE OF THE UNITED STATES

Year	Ratio
1831	22 to 1
1869	53 to 1
1879	62 to 1
1889	65 to 1
1899	63 to 1
1904	74 to 1
1909	74 to 1
1914	80 to 1

Success in cotton manufacture rested only with the man who raced to install new devices, and this new equipment became obsolete in five years. The manufacturer without money to adopt the latest inventions lost his trade and his mills. This struggle for supremacy by means of mechanical devices compelled the business to be capitalistic.

Water Power

When one grasps the idea that cotton manufacture demanded large amounts of power and great aggregations of capital it is easy to see why New England should grip and hold the headship of the industry. The glacier that once crept across New England left as its heritage numberless swamps, ponds, or lakes that now act as a series of reservoirs conserving the floods and preserving an even stream flow. The glacier, too, twisted the rivers out of their accustomed courses and made them seek new paths across uncut ledges, thus producing power sites. The double endowment of waterfalls and regular stream flow gave to New England a power resource that was the foundation of her industrial prosperity. She was equally fortunate in respect to capital. Her years of supremacy in foreign commerce had filled her coffers with gold, making her the early money center of the United States. It was no accident that placed the first American bank in Boston, and it was the money of Boston merchants that financed the cotton industry when it entered upon its rapid expansion after 1813. By 1834, seven-eighths of the merchants of Boston were identified with New England manufactures as stockholders, directors, or agents. No other section of the country to a like degree possessed both the money and the cheap power needful to develop cotton manufacture, so New England almost monopolized the business.

Child Labor

The larger mills, of which those at Lowell were a type, differed strikingly from the establishments set up in the neighborhood of Providence through the influence of Slater. Besides introducing English machines Slater carried into his mills English practices. As in England, so in Providence, the whole family was employed in the factories. Little children were especially sought because they were both deft and cheap; the first nine people hired by Slater were seven boys and two girls less than twelve years of age. At Lowell, children were seldom seen in the mills, partly for the reason that the founders objected to them on principle and partly because children were unprofitable. The Lowell capitalist owned boarding-houses as well as factories; to get a reasonable return on the money invested in the houses the workers had to be able to earn sufficient wages to pay board that would yield a profit to the landlord. Children could not earn enough to pay for the space and food they consumed in the boarding-houses, so the factory-owners discouraged every attempt to force children into the mills. There were plenty of full-grown young women anxious to work, who while in the factory produced more yarn or cloth and when boarding could afford a relatively high rate; why then bother with child labor? Around the older, more settled town of Providence the deficit from children's work fell on their families; hence, the manufacturers gained by employing the little tots.

Wage Payment

Slater brought into Providence too the system of payment in kind rather than in money. He established a company store and issued checks good at that store where the people actually exchanged the sweat of their brows (or their children's) for tea, sugar, flour, or dry goods. This scheme has inherent in it the possibility of unscrupulous injustice through the manipulation of qualities or prices of goods at the store; it makes possible real wage slaves. The Lowell mills from the beginning paid wages in money and helped fix that system in America.

The paternalistic régime at Providence deviated from the capitalistic rule at Lowell in the attitude of the employers toward their responsibility for the morals of their work people. Slater established the first Sunday School in America at his factory, but the girls of Lowell built their own churches, organized their own debating societies, and even published a paper without direct aid from their employers. The factory-owners reasonably safeguarded the morals of the boarding-houses, but aside from that the workers were responsible to themselves. The paternal feeling evidenced by Slater and his group was heightened of course by the youthfulness of their working force. It bespeaks a consciousness of superiority to feel oneself accountable for the ethical obligations of another, an attitude contrary to sturdy American independence. It is well therefore that the Providence factory system did not take root.

British Contrasts

Just as there were elemental differences between the Lowell and Providence mills, so also were there contrasts between the American cotton factories and the English. The fundamental factors influencing our establishments were cheap power and raw material, while England's advantage lay in skilled but cheap labor. These divergencies showed themselves in the adoption of machinery, the speed at which machines ran, the quality of product, and the type of labor employed. Where the English accomplished results by hand-labor we used machines, since our labor was scarce and high priced while machines could be operated cheaply. Power cost us only one-fourth what it did the English because we used water where they burned coal, so we could be prodigal with power while they were forced to conserve it. Consequently we could run our machines faster than they. This showed itself in the means employed for the transmission of power; our machines were belt-driven instead of being geared as were the English, because belts gave greater speed although at a greater expenditure of power. In the ordinary fortnightly wage period an American throstle warp-spinning machine produced 10,080 pounds of yarn, but the English had to be content with 6,345. Again, the United States turned out 63 hanks per spindle, where England's product was only 47.

Higher Quality

England came to the fore, however, where quality rather than quantity was concerned. This was owing partly to the fact that our market made less demand for the finer grades of yarn. It was due partly also to the dryness of our climate. The dry climate aggravated the generation of electricity by the machinery—fast-moving belts and the like—and as a result the yarn was coarser and rougher than the English.

But the chief cause for the better quality of English yarn was the difference in labor. English labor was skilful enough and cheap enough to spin yarn two or three times as fine as the best we could furnish. The reason is connected with the fact of the predominance of women in American cotton factories. Whereas in England at the period referred to female cotton workers exceeded male workers by only 9 per cent, in the United States they exceeded the male workers by 110 per cent. But the finest yarns are spun on mules which require high-grade male labor. Since we did not have male labor we could not do mule spinning. On the other hand, since up to 1830 we had no mule spinning, our mills were not forced to hire many high-priced men.

There was a difference between the two countries, however, in the character of their female labor. In England it cast a stigma upon a girl's name to be known as a member of the mill group, but in the United States the best young women of the community were encouraged to enter the factories. The only kind thing Dickens said about the United States in his "American Notes" was a tribute paid to the women factory workers at Lowell. The difference in attitude toward the workers in the two countries may well be exemplified by the terms generally used concerning them; in England they were called "hands" and "servants," but in America they were known as "helps."

British Specialization

The cotton industry of the two countries reflected also the differences in age and economic development and trade interests. Old England had to contend with the long-established hand-trade customs when mills were set up, with the result that her factories like her artisans specialized upon spinning or weaving; few plants did both. In young America without vested artisan classes, cotton-mills since 1814 have usually performed all the operations for cloth production under one roof. England, too, primarily interested in foreign trade, was forced to manufacture a variety of lines and so had a number of small plants specialized upon variety produc-

World's Cotton Spindles—1914

Country	Number
Great Britain	55,576,108
United States	30,579,000
Germany	10,920,426
Russia	8,950,000
France	7,400,000
India	6,400,000
Austria	4,864,453
Italy	4,580,000
Latin America	3,100,000
Japan	2,250,000
Spain	2,200,000
Belgium	1,468,838
Switzerland	1,398,062
Other Countries	2,499,421
Total	142,186,308

tion. The American mills had one great domestic market whose needs were for standard cloths. England specialized whereas we standardized. The three great centers, Manchester (England), Lowell, and Providence, represented three types of industry but time tends to bring all three closer to a par because water power has been superseded. In 1914 the total number of cotton spindles in the world were distributed between the various countries as shown in the preceding table:

Steam Power

After the founding of Lowell upon the basis of large-scale water power utilization and capitalistic enterprise, no new element entered cotton manufacture until 1850 when coal first threatened the supremacy of water. Although steam had been used as early as 1801 and Slater had installed engines at power-starved Providence in 1827, water power was so cheap that steam could not hope to compete with it. For example, at Easton, Pennsylvania, near the anthracite coal fields, water power cost in 1839 only $23 per horse-power, whereas steam was $105. Even later, in 1846, when steam engines had been improved, steam power cost $90 per horse-power–year in Massachusetts, and $45 in Glasgow, Scotland. Compare these figures with $12 per horse-power–year, the cost of water power at Lowell, and the reason why steam was not popular in American cotton factories is apparent. As late as 1860, with coal at $6 a ton, steam power cost $27.90 per horse-power–year or more than twice as much as Merrimac River power. Yet steam began to supersede water power in 1845, for the reason that water wheels or turbines although cheap, were not elastic. The limit of expansion of mills at a power site was the maximum water power available at that point.

By 1830 the smaller streams had been developed to their utmost capacity. Ten years later the Blackstone had along its banks 94 cotton factories, 22 woolmills, and 34 machine-shops, crowding every available site and exhausting the last drop of energy in the stream. Even Lowell had to supplement her water power with steam auxiliaries in 1845. So it was not so much a question of comparative costs where water was obtainable, as it was the ability to expand with the growing demands of the market. Mills driven by water were held within the bounds of the capacity of their particular site; beyond that they could not grow. Meanwhile steam engines were being rapidly improved so that their cost of operation was lowered at the same time that their efficiency was raised. Installed at first as an aid to help carry the overload of water-driven factories, they have gradually assumed almost the entire burden, and relegated water power to the position of a subsidiary useful for an emergency. Following is a comparative tabulation of the primary horse-power used in the manufacture of cotton goods and small wares in the United States in the last two decades.

PRIMARY HORSE-POWER USED FOR MANUFACTURE COTTON GOODS AND SMALL WARES

Year	Steam	Water	Internal Combustion Engines	Electricity
1899.........	531,621	251,850	321	17,594
1904.........	708,333	252,923	1,786	67,139
1909.........	877,201	303,024	2,812	235,902
1914.........	1,011,303	314,219	4,016	512,903

Seaboard Mills

General Charles T. James was the first advocate of the steam engine for use in cotton-mills. He claimed that the ideal location for a cotton-mill was at a seaport where coal could be brought cheaply by barges. Owners of inland, water-driven plants naturally scoffed at this idea, but James had the strength of his convictions and started four projects at tidewater in the towns of Salem, and Newburyport, Massachusetts, and Portsmouth, New Hampshire, all towns whose commercial activities had been absorbed by Boston and who therefore welcomed the new outlet for their energies.

These places, however, have not so ably and strikingly demonstrated the truth of James's theories as have the mills built at Fall River and at New Bedford. Notwithstanding that Fall River's earliest mill was established in 1813 as a copy of Slater's in near-by Pawtucket, and that the town was endowed with a small stream whose rapid fall in a short distance gave the town its name, nevertheless cotton manufacture was of little consequence until after 1865. Fall River's prosperity is founded on coal power and not upon the influence of its little river. Situated upon an arm of Narragansett Bay, coal can be brought by barge almost to the mill doors. Since water transport is so cheap, this makes the first cost of coal at Fall River low, and it also saves an expensive inland railroad journey. On the other hand, coal used at Lowell is shipped to Boston and there transferred to the railway cars for haulage to Lowell. In Fall River, furthermore, there was no check, so far as power was concerned, to the growth of cotton mills because steam engines could be multiplied at will.

Damp Climate

Although steam power is the fundamental factor in the prosperity of the seaboard cotton-mills, there are other factors that have been of vital importance, chief among which is the matter of climate. Atmospheric conditions are of the utmost importance in cotton manufacture, since a high degree of humidity is necessary for fine spinning. The rubbing that yarn gets in spinning creates frictional electricity which causes the strands to tangle. Moist air being a good conductor helps to carry off this electricity; aridity on the contrary not only does not remove electricity but aids to produce it. Humidity increases the elasticity of cotton because the yarn absorbs moisture up to 35 per cent of its weight. A damp yarn spins easily since it is not apt to snap or curl; accordingly the output of a spinning-room varies from 5 to 10 per cent, conformable to the dryness or wetness of the air. A similar fluctuation is noticeable in weaving, for if the air is dry the warp threads break constantly, causing frequent stoppage of the loom and increase in cost through the lessened output. This loss alone may amount to more than $150 per day. Aside from this effect on the yarn or cloth, dampness influences the standardization of the belts, Jacquard cards, loom harnesses, and shuttles. As a consequence of all these factors the air in all cotton spinning-rooms is kept almost saturated.

By the borders of the sea this desirable atmospheric condition is produced by the presence of the ocean itself, whereas inland mills are forced to depend entirely upon artificial means. A New Bedford mill may work with its windows open because the air is naturally in the proper condition, but a Lowell or Manchester, New Hampshire, factory must lock its windows, spray steam into the rooms, and compel its employees to work in this stuffy, confined atmosphere. Since health and economy are both promoted in mills near the coast, nearly every great textile center is in such a location. Bombay, India; Lancashire, England; Philadelphia, Pennsylvania, and southeastern Massachusetts are all good examples of locations possessing naturally this necessary atmospheric condition.

Mill-Owners

Another difference between the maritime and inland plants is the residence of the owners of the mills. Both Fall River and New Bedford were developed by local capitalists, while on the contrary the mills of Lowell or Lawrence were the property of merchants whose homes were in Boston. The men who own the factories of Lawrence seem to have little interest in the place as a social community. This indifference could be tolerated if the working people had been born in Lawrence, or owned homes of their own; but with the population so largely foreign born (48 per cent) there is no group whose interest in Lawrence is sentimental rather than financial. New Bedford, despite its large alien population, has a coterie of old families that possess a personal attachment for the old whaling town. Absentee landlords seem to be as socially detrimental to American cities as to Irish farms.

Because of these things—personal interest of inhabitants, naturally favorable climate, and advantageous location in respect to coal—the coastal cotton centers have advanced far beyond the earlier established inland mills. New Bedford has attained the distinction of being the greatest cotton-manufacturing center in the United States, while Fall River, long the leader, now follows close behind. New Bedford also claims first rank in quality of products. As late as 1850, the finest cotton yarn in our country was only No. 90. Today New Bedford spins as high as No. 140. The comparative standing of the leading cotton-manufacturing centers of the country in the years 1914 and 1909 is shown in the following table:

PERCENTAGE OF TOTAL COTTON MANUFACTURED IN THE UNITED STATES

City	1914	1909
New Bedford, Mass.	7.4%	6.8%
Fall River, Mass.	7.1%	7.7%
Lowell, Mass.	3.3%	3.9%
Philadelphia, Pa.	2.8%	3.6%
Pawtucket, R. I.	1.9%	2.3%
Warwick, R. I.	1.1%	1.2%

Foreign Labor

The high grade of American cotton factory labor unfortunately has not been maintained. The first employees were natives and came from the best families; in 1826 for example, of the 612 operatives at Fall River only 38 were foreigners and 28 of these were in the print works. In 1842 at the Merrimac Mill of Lowell employing 1,500 people, only 50 were foreign born and these were all British. But soon thereafter a change crept into our working forces; Irish immigrants began to flood the mills in 1846, followed by thousands of French-Canadians, who in turn have given place to hordes of Portuguese, Poles, Italians, and Greeks. Today, Manchester, New Hampshire, is a French-Canadian town with French as familiar a language as English. In 1918 it had a French-Canadian mayor who was forced to hire an interpreter for his official English correspondence. Lowell mills are now manned predominately by Greeks, Lawrence by Italians, and New Bedford by Portuguese, Poles, and French-Canadians. The following table is illuminating:

PERCENTAGE OF TOTAL WHITE POPULATION—1910

Place	Foreign-Born	Native Parents	Mixed Parentage
Lawrence, Mass.	48%	13%	37%
New Bedford, Mass.	44%	19%	33%
Fall River, Mass.	42%	13%	43%
Lowell, Mass.	40%	19%	39%
Massachusetts	31%	32%	34%
Iowa	12%	58%	28%
United States	14%	53%	20%

Low Wages

The cause for this change lies in the development of machinery to offset the constant fluctuation in the original native working force. A machine made so simple in operation that an untrained American girl could in a short period operate it successfully, paved the way for the employment of immigrants when the American standard of living was raised. The result is that wages have been kept down because each successive wave of immigrants has had a lower standard of living than the one that preceded. Inasmuch as the nationalities were mixed and often antagonistic, there was no common ground of blood or religion to form a basis for unions to raise wages by concerted action. Except for mule spinners' unions formed among English and Scotch workers at Fall River, and I. W. W. organizations at Lawrence, there has been no united effort to raise wages by cotton-mill workers.

Southern Mills

In all the years since the first fully equipped mill started at Waltham (1814), the leadership of New England in cotton manufacture has been threatened seriously but once. The inauguration of the business in the South, in 1870, sent an apprehensive chill through the mill towns of the North because all the advantages seemed to lie in favor of the newly opened piedmont factories. In the first place the Carolina and Georgia mills were erected in the midst of cotton fields; then too labor recruited from "poor whites" in the mountains was extraordinarily cheap; for example, in one mill the total year's wage per operator was at first only $169. Hydro-electric power developed from mountain streams, the newest and best mill equipment, a large home market, freedom from onerous legal restrictions, and finally low taxes; all of these superiorities seemed to give the benefit of material advantages to the South.

Drawbacks in the South

But the situation was not without its drawbacks. The nearness to the raw material was offset by the freight charges on the cloth sent north to be sold or dyed. The South lacked converting plants in which cloth from the looms could be bleached, dyed or printed, and surface-finished. The saving on carriage of raw material was more than counterbalanced by the necessity for paying a larger sum to get the woven product finished and sold. Take this comparison of expense for cloth sold in New York City:

	Massachusetts	Georgia
Freight charge per 100 lbs. on raw cotton....	$.656	$.403
Freight charge per 100 lbs. on cloth.........	.16	.556
Total	$.816	$.959

Excess Georgia over Massachusetts, $.143.

Furthermore every southern mill utilized only certain grades of raw material which had to be secured from a wide area; thus Georgia mills in the midst of cotton fields were compelled to import Texas cotton upon which the freight rates were frequently higher than to New England.

Likewise in regard to labor, the southern mill-owners learned that cheap labor did not mean low labor cost. Since the mountain whites were not accustomed to regular work, the mill rolls contained two or three times as many names as there were ever actually people at work. To insure a complete force of a hundred, say, the superintendents had to carry on their books three hundred operatives. Furthermore the poor whites were not skilled in machine operation and so wasted much raw material as well as producing a poor quality of yarn and cloth. These things made the labor cost per unit of product a large figure while at the same time profits were kept low by the inferior grade of workmanship. The mountain folk too required more vigilant supervision and inspection than the employees in the northern mills, another factor adding to the costs and lowering profits. Negroes did not enter into the labor question in southern mills because they would have accentuated all the faults of the poor whites; that is, they were even less constant, less deft, and more necessary of supervision. A negro could not sing in a cotton-mill, and everyone who knows colored people at all fully appreciates that a negro who cannot sing at his work, cannot work. Of course the greatest obstacle to employing anyone but a white person in southern mills was the social question. Working forces had to be either all white or all negro; no mingling upon the same work was tolerated by either color.

Subsidiary Enterprises

As with cheap labor, so with cheap power, low taxes, and tax laws, the advantage of the South was more apparent than real. The southern mills repeated the early history of Massachusetts in that, in order to operate a factory at all, whole new towns were created and supported. For example, one Georgia corporation owned a hospital, hotel, bank, three churches, two kindergartens, a school, and two stores, besides giving financial assistance to a lecture course and equipping military and baseball outfits. This case was not at all unusual. It meant that companies operating in the South were compelled to sink large amounts of capital in enterprises subsidiary to their mills, and that the interest on these investments more than offset the savings made in other directions.

New England's Advantages

On the other hand New England's advantages, although not so obvious as Carolina's or Georgia's, were sufficient to maintain her leadership in American cotton manufacture. A long-established industry gave her a labor force the majority of whom were trained to the work; the unproductive "green help" was always in the distinct minority. This enabled the northern mills to turn out goods of high quality at a low labor cost. The New England mills also had plenty of capital at their disposal, and very little of it needed to be diverted into channels outside the direct production of cotton cloth. This free capital enabled the northern factory agents to purchase cotton in the best market and to store it against need, and at the same time to take full toll from any discounts allowed for cash payments. Secondary plants, such as dye houses, bleacheries, or print works, were plentifully distributed throughout the northern textile centers, offering the cotton-mills both a convenience and a saving in freight charges not common in the South. Massachusetts leads all the other states in this respect contributing, in 1909, 26.2 per cent of the total value of products reported for the whole industry in the United States. Cotton manufacture in New England was concentrated in a few localities whereas in the South it was scattered. This localization was a benefit to the North because it offered a reservoir of trained labor upon which the mills might draw at will; it enabled mills to buy raw materials co-operatively and to get the lowest freight rates because so much of the commodity was carried between the same points; it favored selling because purchasers were attracted to a recognized center; and finally it promoted the interchange and rapid assimilation of new ideas. Since the southern mills were isolated they lost all these advantages.

Humidity

One big factor favoring New England, although seldom mentioned, is nevertheless of primary importance. The large maritime mill towns of the North are in a more favorable climatic environment for cotton manufacture than the inland piedmont mills of the South. The advantage of a humid atmosphere has already been pointed out. That the climate of coastal New England is better adapted to cotton-making than that prevailing in the southern mill section is readily apparent from the following:

Comparison of Humidity and Rainfall

Place	Humidity 3-yr. Mean 1878-80	Lowest	Average Rainfall in Inches	Extreme Variation
New Bedford, Mass.	82%	40%	46	10%
Charlotte, N. C.	65	25	53	17
Wilmington, N. C.	71	27	54	..
Atlanta, Ga.	64	27	54	17
Lancashire, Eng.	82	..	36	..
Derbyshire, Eng.	87	..	56	..

The New England coast has a humidity of about 75 per cent all the year, the highest monthly average being 80 per cent and the lowest 70 per cent. In the piedmont there is considerable variation from month to month, the late winter months being extremely dry, and the air is much drier at all times than in New England. The piedmont has more settled weather and less cloudiness; the number of cyclonic storms is only one-third that of New England. Clouds screen the earth from excessive radiation or isolation thus aiding in maintaining an even humidity. New England with a smaller annual rainfall has a larger number of rainy days than the piedmont. The conclusion is inescapable that New England is better adapted for cotton manufacture than the piedmont mill section of the South. Artificial spraying will modify mill humidity to any degree, but such spraying is an expense and produces an unnaturally stuffy atmosphere to which the workers are not accustomed and which exposes them to disease when they go out into the open air where the relative humidity may be quite different.

Comparative Production

The fact that the South has entered largely into cotton-manufacturing, however, must not be overlooked or minimized. The following figures tell their own story:

PERCENTAGE OF TOTAL VALUE OF COTTON GOODS MANUFACTURED IN THE UNITED STATES

Place	1909	1914
Massachusetts	29.7%	28.1%
North Carolina	11.6	12.9
South Carolina	10.5	11.2
Georgia	7.6	8.6
Rhode Island	8.0	7.1
Massachusetts and Rhode Island	37.7	35.2
The South	29.7	32.7

It is evident that the South is rapidly cutting down the lead of the principal New England cotton-mills in the gross value of output. Yet the disadvantages under which the southern factories operate prevent them from much direct competition with the North. The South manufactures coarse, heavy goods valuable chiefly for the cotton they contain rather than for the skilled labor put upon them. The North does just the opposite; she makes goods whose principal value lies in the workmanship and not the raw material. These facts reflect the advantage the South has in nearness to cotton fields and the North in possession of a trained working force.

The value added to cotton by manufacture in the several states is as follows:

PERCENTAGE OF VALUE ADDED TO COTTON BY MANUFACTURE

State	
Rhode Island	42%
Massachusetts	40
South Carolina	33
North Carolina	32
Georgia	31

There is the same relative difference between New England and Manchester, England. In over a hundred years of experience our best mills have not been able to overtake England's best. It is reasonable to suppose, therefore, that the adjustment between the North and South within the United States will continue for a long time to come.

Summary

To summarize briefly the whole history of American cotton manufacture, it has been shown that before 1813 the industry, although established, was not prominent, but that beginning with the first complete mill at Waltham the manufacture of cotton has rapidly come to the forefront. The need for large water powers and much capital localized the industry from the start in New England enabling that section to obtain and maintain first place. The inelasticity of water power together with the continuing expansion of the business, paved the way for coal as a source of power. This had the effect of raising coastal manufacturing towns above those inland to the headship of the industry. Of late years the introduction of cotton manufacture into the South has threatened the ruin of New England's industry, but direct competition is not as yet effective because the South must be content to make the coarse, heavy goods while New England specializes upon the high grades.

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CHAPTER VII

WOOL MANUFACTURE

Age-Long Use

Although wool and cotton have many similar uses and are manufactured by somewhat analogous processes, the economic factors that have affected them fall into quite different categories. Cotton, an age-long luxury, at no time a common household manufacture, was suddenly thrust into the class of staples by the transformations wrought by the industrial revolution. As a common commodity it has been a machine-made, factory product, subject only to the influences that have beset our factory enterprises without the entangling complications that have accompanied the transfer of ancient, well-known hand-trades to new machine bases.

Wool, on the other hand, has been used for the comfort of man for so many ages that no one knows how many centuries have passed since the first man protected his body from the rigors of climate by clothing himself in the fleece of sheep. The manipulation of wool is as ancient and intimate in the annals of men as the baking of bread. It is to be expected then that wool manufacture would yield more slowly to great modern economic changes and be less affected by them than cotton whose manufacture was really part and parcel of those changes. The long-cherished hand methods of wool manufacture gave ground slowly before the assaults of modern inventions; and complex, large-scale, capitalistic production did not become common until after such organization was a by-word in the allied cotton industry. Even then it was not until a new wool product brought to the wool industry conditions that had always existed in the cotton that wool manufacture partook of the character of the cotton.

Agricultural Importance of Sheep

Sheep-raising has had this ancient history because sheep could be easily herded under a pastoral scheme of life and were especially desirable adjuncts to a farm after men settled down to agricultural pursuits. Sheep, like their kin the goats, are excellent scavengers, clearing the ground of roots, shrubs, and rubbish, while at the same time they add to the fertility of the soil by their excrement. Farmers nearly everywhere have kept a few sheep for these purposes. It was in keeping with this age-long policy that Columbus carried sheep upon his second voyage to America. Later in the various colonies agriculture was so predominant that the presence of sheep on most farms was to be expected; these were as fully a part of every household's domestic economy as the kitchen kettle. The London Company sent sheep with the first colonists to Virginia in 1607. Thirteen years after the Pilgrims set foot on Plymouth Rock, sheep were introduced into Massachusetts and the few that were then sent had multiplied to 3,000 head by 1640. At the Dutch colony of New Netherlands, sheep were supplied by the Dutch West India Company in 1625.

Sheep-Raising

Although sheep were found in all of the settlements both North and South, natural conditions tended to concentrate sheep-raising in the North. Docile, non-combative sheep were peculiarly liable to attack by wolves, and unless they were protected the flocks were soon decimated. The large plantations of the South, with their widely separated unco-ordinated households offered little protection against these enemies. Furthermore the keeping of sheep as an agricultural adjunct was not a necessity upon the southern plantations, because the same fields were not used from one generation to another, but instead new lands were cleared and set into crops as the old ones became exhausted. Southerners were more prone to use linen or calico for clothing than wool because their mild climate permitted it. On the contrary, in the North the typical village life favored the nurture of sheep because the families lived close enough together to drive their sheep into one common flock by day over which the town appointed one or more guardian shepherds. Some communities, particularly in Massachusetts, placed a bounty upon wolves in order to keep down their incursions. The places which afforded the best protection for sheep, and therefore were most fully used, were the islands found in Boston Harbor and Massachusetts Bay; it is worthy of note that even to this day sheep are raised in considerable numbers upon the island of Nantucket. During the whole colonial period the average stock found upon a New England farm comprised two horses, one or two yoke of oxen, and ten to twenty sheep.

Secondary Need

The primary purpose of these sheep was to clear and fertilize the land, but they fulfilled also a secondary need in supplying wool for the members of the household. As a rule this wool was prepared, spun, and woven by the members of the household itself; wool yarn and cloth, as a consequence, seldom entered into domestic commerce. In order to encourage this household industry some of the colonies, notably Massachusetts, imposed the rule that each household spin and weave a minimum amount of yarn and cloth each year in proportion to the number of female "spinsters" the household contained. In 1655, for example, in Massachusetts, each family was forced to prepare 3 pounds of woolen cotton or linen yarn per week. As an example of what could be done, in New York State, in Schoharie County, the daughter of one Walter Briggs, in competing for a prize offered by the county, wove 1,200 yards of wool cloth from the fleece of three hundred sheep in one year. In many cases however the yarn only was prepared by the women in the households, while the cloth, although woven under the family roof, was produced by itinerant weavers who happened to pass that way, because weaving required more strength and training than spinning.

Fulling-Mills

The first complete break in household self-sufficiency occurred with the establishment of fulling-mills. By fulling is meant the shrinking, shearing, and finishing of woolen cloth after it has been woven, a job that calls for considerable skill as well as strength and is best done by means of special equipment. Most heads of households were not skilled in this work, nor did they have the equipment by which it could be most easily accomplished; consequently, fulling very early became a separate industry carried on by special individuals at places particularly well favored with bountiful supplies of soft water and accessible to the largest number of patrons. The first fulling-mill was set up by John Pearson at Rowley, Massachusetts, in 1643, while a second one appeared in Watertown, Massachusetts, in 1662. This town had another pioneer mill erected in 1686. The third, in the order of erection, was located at Dedham, Massachusetts, in 1681. In Connecticut the first mill was at New London in 1693; in New Jersey the first was at Rahway in 1703. Pennsylvania had several mills by 1700. In Virginia the first mill dates from 1692. By 1700 fulling-mills had become too numerous and too common to warrant special mention; in fact, nearly every community included a fulling-mill among its necessities of life. The first fulling-mill to utilize water power was one in Byfield, Massachusetts, in 1794.

Manufactories

At the close of the Revolutionary War, a further departure was taken from the prevailing system of textile work exclusively within the home by establishing within Atlantic coast cities what were called "manufactories." These projects were really industrial poorhouses and accomplished the double purpose of supplying work to the worthy poor and at the same time doing something to sever American economic bondage to Europe. These manufactories appeared in Boston (1784), Philadelphia (1787), New York (1788), Wilmington (1789), Baltimore (1789), and Portsmouth (1789). They were the American counterparts of hand-work factories founded in England during the domestic system, the real forerunners of modern factories, although they were without machinery and of course did not utilize mechanical power. The American manufactories served to focus attention upon the textile industry and taught spinning to a large number of people who were unacquainted with the art. In so doing they may have paved the way for the later development of factories operated by machinery.

Output of Households

It must not be misunderstood, however, that fulling-mills or manufactories encroached much on the dominant system of spinning and weaving in each household. At the time the first federal census was taken, there were only three woolen-mills in the United States, whereas from two-thirds to three-fourths of all the clothing worn in this country was made upon the premises of the people who wore it. The balance was made up by imports from England, France, or the low countries. People in the cities or near the coast were large purchasers of foreign-made cloth, but all the rest of the population supplied their needs from their own toil.

As a rule no individual communities became noted for the production of any wool commodity; to this generality, however, there were a few exceptions. Germantown, in the environs of Philadelphia, early became famous for its knitted woolen stockings and helped to supply all of the colonies with these articles. This industry was centered there because a large number of immigrants from the Palatinate, who founded the village, brought to this country the art and skill acquired in their ancestral homes. To them, and the early start they gave in wool manufacture, Philadelphia owes her present-day eminence in the industry. Likewise certain Englishmen from Yorkshire, long trained in wool manufacture, who settled at Rowley, Massachusetts, made that town unique in the amount and variety of wool products. Irish immigrants from the linen-producing section around Londonderry, upon planting themselves at Londonderry, New Hampshire, made that settlement distinguished for the manufacture of linen and wool cloth. A small group of Moravians at Bethlehem, Pennsylvania, were likewise renowned for their wool products. These towns, however, were entirely exceptional; for the most part, wool was manufactured where it was grown.

Early Slow Development

Following the Revolutionary War, in the period when cotton manufacture was going ahead with vigor, the wool industry made feeble response to the changed conditions. One promising project organized at Hartford, Connecticut, and known as the Hartford Woolen Manufactory, began business in 1788. Although this mill was exceptional among woolen industries in that it employed water power in part at least, and notwithstanding that it manufactured woolen cloth of sufficiently high grade that President Washington did not disdain to clothe himself with it, and indeed wrote a complimentary letter in regard to it, nevertheless, in 1795, when the period for which it was incorporated had passed, the business was closed. Even in 1810, there were only 24 woolen factories in this country, of which but 4 manufactured high-grade cloth, while at that time there were no less than 87 cotton-mills.

The first wool spinning machine to be set up in a factory in this country was at Peace Dale, Rhode Island, in 1804, an experiment that stood almost entirely alone until 1819 when spinning machinery for wool became more common. In contrast it will be remembered that cotton-spinning was done by machinery as early as 1790. Although the various spinning devices first used for cotton were gradually adapted to wool, it may be said that our wool-spinning machinery lagged far behind the mechanical improvements used in cotton manufacture and even behind those used in the English wool factories.

American Weaving Inventions

We Americans never made many real original contributions to this department of wool manufacture; on the other hand we can take considerable pride in our achievements with weaving inventions. This circumstance must be attributed to the greater savings that resulted from improvements in weaving. Generally the division of labor apportioned a preponderance of women in the spinning department while men were more numerous in the weave sheds. The higher wages paid to men occasioned a greater net gain from improvements in weaving. The first power loom for weaving wool cloth is supposed to have been operated in Southbridge, Massachusetts, in 1823. Two years later a broad loom was built and run in a Berkshire factory. However, hand-looms were more commonly used than power ones until after 1830, when the machines gradually displaced the ancient methods. The first loom for weaving fancy cloth was invented by an American named Crompton and was placed on the market in 1840. This loom was very ingenious and increased the speed of weaving from 45 picks per minute to 85. Soon afterwards Erastus Bigelow brought out his well-known carpet loom, by which the wholesale price of carpets was reduced 30 cents a yard and carpets were placed within the reach of the whole population, and not confined to those who could afford luxuries. The three names that stand out in the invention of looms and improvements upon them are William Crompton, Erastus Bigelow, and Lucius K. Knowles; these three men, with their assistants and competitors, were responsible for placing American weaving machinery on a par with the British, because of their constant betterments in the action, speed, expense, and output of looms.

British Embargoes

It is worthy of notice that the fundamental inventions in cotton manufacture were entirely completed by 1836. Since that time improvements in cotton manufacture have largely been in matters relating to increased speed, greater precision, or minor labor-saving adjustments. In contrast to this it is remarkable that the most important wool machines were not all developed until as late as the Civil War. In every particular woolen manufacture failed to progress as rapidly toward the modern factory system as the allied textile, cotton. Although woolen-mills were scattered all through the states before the Civil War, and the aggregate number of them was very large, approximating 2,000, nevertheless, when we entered that contest American woolen manufacturing was at least twenty-five years behind common English practice. This condition was so different from that which prevailed in the cotton business that it is worthy of a rather lengthy explanation.

In the first place, our earliest woolen-mills were held in check by various English laws and English actions. The laws that prevailed in England between 1660 and 1825, and which prohibited the export of any part of any mechanical device, acted as a decided bar against knowledge of improvements in this country. This, alone, however, does not account for our poor showing, for we Americans were forced by the peculiarities of our environment to develop our own machinery. Since the localized English mills operated on one grade of yarn only, in any one factory, the machinery was designed to produce only this one standard product. On the contrary our mills scattered on remote streams, working any local raw material that chanced to be available, and producing any commodity the customer demanded, required machinery that was extremely adaptable. Inasmuch as we could not copy English models, we were compelled to evolve our own. Nevertheless our genius might have been much enriched by English ideas, if the English laws had permitted a free transferral across the waters. As it was, we either perfected our crude machines by slow, costly experiments, or stole English improvements by whatever means we could devise.

English Competition

Besides refusing to give us outright the benefits of her mechanical brains, England hampered our unsteady manufacturing progress in other ways. America was one of the best export markets that the English wool manufacturers had found; for instance, between 1790 and 1799 the United States imported from 25 to 41 per cent of the entire product of the English mills. This market was altogether too good to pass without contest to incipient competitors on this side of the Atlantic. Consequently, the English merchants poured woolen goods into this country, selling them by auction at prices under the cost of production of our own feeble mills. No less than $70,000,000 worth of wool and cotton cloth were imported into America after the close of the War of 1812. English agents, too, were said to have passed through the northeastern counties buying the best wool-producing sheep and sending them to the nearest butcher in order to remove this potentially competing raw material. It is claimed, also, that their agents went from one small factory to another through the middle and northeastern states purchasing the best machinery that was there available. This machinery was then knocked down, boxed, and shipped to England, thereby snuffing out part of the most effective competition here.

England was better equipped with dyers and designers than the American mills. These two groups of artisans are the real keys to success in wool manufacture, because upon their skill and foresight depends the profitable operation of a woolmill. Dyeing, particularly, was an art little known in this country. In fact, the first use of dye-stuff in the colonies was to alleviate the labor of too frequent clothes-washing. The dyes were simple and made from vegetable products, such as butternut bark, sumac, etc. Lastly, in 1833, England entered upon her era of free importation of wool, by which means she secured the wool resources of all the world for her factories. A corresponding liberty of choice has never been opened to American wool manufacturers because our tariff has always shut out some grades of wool. For these reasons, then, England from the very beginning and down to the Civil War was able to maintain a leadership far ahead of American competitors.

No Aid to Mills

In the second place, American mills were not aided by the first inventions in the woolen industry, but rather those inventions tended to increase the efficiency of household equipment. Such machines as portable spinning jennies, improved cards, and carding machines for preparing the wool fibers for spinning—all of these were manufactured and sold to individual households rather than set up in independent factories. Furthermore, none of the early inventions called for a drastic change in the fibers employed such as did the change from linen to cotton. The ancient wool industry was little disturbed by the improvements made in it, and therefore tended along its well-established lines as a household production for a considerable period after the first inventions.

Lack of Raw Material

Our early mills suffered as well from a lack of raw material. It has been said that nearly every northeastern farm supported from fifteen to twenty sheep, which might seem to give sufficient raw material for the factories to operate. But when it is considered that nearly every household contained ten persons and that the fleece of two sheep was required to clothe and keep warm each person, it can be readily seen that there was not only little wool to spare from off the farm, but hardly enough to supply the necessities of the farm itself. Wool was scarce at all times. During the Revolutionary War colonial soldiers who brought a blanket with them were not only allowed to keep the blanket as their own, but were paid $2 out of the public treasury. In Philadelphia, in 1775, the people voluntarily gave up the eating of mutton and lamb in order that the sheep might be saved to supply the much needed wool at that time. It is computed that some 20,000 sheep were thus preserved from the butcher. These examples serve to point out the general truth that we have never had a surplus of raw wool.

Sheep-Raising Costly

The reason why larger flocks were lacking was that sheep were not bred as a separate industry. Their presence on the farm was not due to their value as wool producers; only such numbers were kept as were needed to clear and fertilize the land. Sheep were altogether too troublesome, too liable to disease, accident, or the attack of wild animals, especially in contrast with such other animal industries as the raising of cattle, horses, or hogs, to warrant very many farmers concentrating much upon their business as shepherds. The sale of meat from sheep was also relatively small, for mutton and lamb, not being bred for the purpose, were quite strong in taste, so consequently were not considered as gentlemanly dishes. They were the food of servants or slaves. Other meats were too available and too cheap to warrant improving the quality of sheep meat. This general disregard of a meat supply now so important and so catered to, was partly responsible for the lack of attention to the raising of sheep. There was, furthermore, no central market where wool could be sold by the farmers or from which it could be purchased by the users of that commodity. As a result of all the foregoing influences, the quantity of wool for use in factories was at all times limited. Correspondingly, manufacturing was curtailed so that during the War of 1812 the blankets which warmed American soldiers were brought from England by way of France, and as late as 1840 the flags or bunting used on every American ship, hospital, public building, or schoolhouse was brought from abroad and not made in this country.

Poor Quality of Wool

Not only was the quantity of wool insufficient to support a thriving factory industry, but the quality was not of a desirable grade. The same factors which tended to a paucity of sheep were also conducive to the production of low-grade wool. Sheep were not sufficiently important to justify special attention being paid to their breed or care. This is quite different from the story which is told of the ancient Romans who were so careful of their high-grade wool sheep that they kept them in specially warmed buildings, wrapped in leather jackets, and washed them daily with wine and sweet smelling oils. England's kings and Parliaments protected and encouraged sheep-raising to such an extent from the time of Henry the Third, and especially Edward the Third, that it became the backbone of her prosperity and was cherished with the utmost solicitude.

Importation of Merino Sheep

The Moors of Spain, by crossing hardy African sheep with weak, delicately reared, but high-grade Roman sheep produced as a result the world-famous merino, whose fine long fleece was the envy of all other nations. Spain maintained a monopoly over these sheep until the era of Napoleonic conquests when she was forced to sell the flocks to maintain the expenses of war.

Fortunately three Americans were sufficiently informed of the value of these sheep to have several thousand of them sent to this country. These men were William Jarvis, who was the American consul at Lisbon, Robert R. Livingston, who was Minister to France, and General David Humphrey, who was American Ambassador to Spain. Jarvis alone shipped 3,850 from Lisbon to the United States in 1809-1810. Through the efforts and exhortations of these men, the breeding of merino sheep became a fanaticism among the farmers of this country. The price of merino wool advanced from $1 per pound in 1807 to $4 per pound in 1814. Individual sheep of pure merino blood were sold at prices ranging from $500 to $1,500. One $10,000 ram which sickened and died in Vermont received as many obituary press notices as a member of a royal house.

Merino sheep were scattered through all the states, even those on the western border, but the states which took precedence in their breeding were Vermont and the Berkshire section of Massachusetts. Elkanah Watson exhibited the first merino in the Berkshires in 1807. By 1810 there were 1,500 in that region and by 1815 Pittsfield alone had flocks totaling 8,000. In 1812 the largest single flock in the United States belonged to the Duponts of Wilmington, Delaware, and numbered 4,300, of which however only 746 were strictly pure blood. Twelve Vermont sheep took two firsts and one second prize at the Fair in Hamburg in 1863 and were sold for $5,000 to improve the grade of Silesian flocks. Vermont sheep have even been sent to Australia to raise the quality of wool there.

Incentive to Factory Building

The introduction of this type of wool into the United States was a direct incentive for the establishment of a wool manufacturing business upon a factory basis, because the "cards"—closely resembling those used in cotton manufacture—which were required for preparing the fleece for spinning, due to differences in the length, fineness, and felting qualities of the wool, were entirely different from those generally employed in the age-long household manufacture.

The first ventures at wool manufacturing, however, were of a decidedly experimental nature. Some early woolmills tried many industrial experiments before finding a profitable venture. For example, the Bemis Manufacturing Company made at different times the following: paper, duck, cotton, wool, ground corn, ground dyewood, chocolate, ground and cut glass, polished lights for lighthouses, and machinery. One of the most famous mills established in direct response to the new material was erected by General David Humphreys at Seymour, Connecticut. Here he established a model village almost as famous in the annals of wool manufacture as Lowell was in the cotton. Some of the mills which were established in response to merino wool when it was first introduced have fortunately survived all the vicissitudes of the wool industry and are in active operation at the present time. General Humphreys' mill, which has passed through many changes, is still in operation.

Relapse to Careless Breeding

Nevertheless in spite of the introduction of the merino, the craze for full-blooded sheep was short-lived and farmers soon returned to their careless methods in breeding. The result of this indifference was that at no time has there been sufficient high-grade wool in the United States to satisfy the needs of our manufacturers. Added to the hampering effect of English laws or practices and the lack of sufficient raw material and particularly of high-grade fleece, our mills were impeded by the absence of any standard staple product. Since the output of the mills was primarily for the use of outer garments for men and women, and inasmuch as fashion constantly demanded a change in goods produced for these purposes, there was no article whose normal steady annual demand could keep a mill operating profitably.

Adoption of Trousers

This situation was relieved somewhat when, in 1812, men began to adopt trousers instead of knee-breeches. Previous to that time trousers had been worn only by sailors and laborers and were usually made of coarse cotton duck or denim. After the introduction of the fashion for trousers, a new cloth called satinet, made with a cotton warp and a woolen weft, was produced to fill the need. Since this was a new commodity that had never been produced in the homes and was of such a nature that it could be best manufactured in special factories, by selecting it as a standard staple product, wool-mills could be conducted with some promise of success.

By 1836 more power was used for the manufacture of satinets than any other two wool cloths. The only other staples which our mills were able to acquire were the manufacture of flannels, shawls, and stockings. American merino wool was usually too long for the making of broadcloth. The fiber ran from 2⅝ inches long to 3½ inches. This long-fibered wool however was very well adapted for the manufacture of the goods just mentioned. Since our mills had an advantage in spinning and weaving or knitting these articles and because the general public set up an insistent demand for them, they became staples. It is not too much to claim that our early mills, especially those which were long successful, could not have maintained their footing if they had not turned to the manufacture of satinet or shawls and similar soft goods.

Lack of Male Labor

Quite as important as any of the foregoing factors in obstructing the progress of wool manufacture was the fact that it required male labor. The small scale of operations and the necessity for frequent change to meet the demands of customers or to fall in with variations in style necessitated skill upon the part of the labor employed. Inasmuch as there was little standardization of product, there could be no corollary standardization or specialization of machines for certain types of work. Instead the machines had to be adjustable, and change in product produced through the skill of the manipulator. The beauty or perfection of any piece of wool cloth was vitally dependent upon the expert workmanship of the employees in the mill where it was made. This threw the burden of wool manufacture upon the men employed and was the chief reason why men alone were serviceable for that kind of work. But the large rewards offered outside of the factories in the exploitation of natural resources tended to draw ambitious men away from the mills and shackled manufacturers in their efforts toward increased production or enlargement of plants. The employees who did consent to remain at their mule spinners or looms were bribed, so to speak, by relatively high wages, with a consequent weighting of the pay-roll that put woolmill-owners at a competitive disadvantage.

Effect of War

After the War of 1812 the revival of shipbuilding withdrew considerable labor that had been flowing to the woolmills during the period of hostilities. At the same time an increase in the price of food and shelter caused a demand for a corresponding advance in wages that cut into the profits of wool manufacture already pared to the bone by the sudden return of foreign competition, so that capital was largely withdrawn from the business. It is significant that the only line of wool manufacture which passed through the successive waves of stimulation and depression without great disaster was the making of wool hats. This was the solitary branch of the wool industry that demanded but few laborers in proportion to the output and the exaction for skill in this labor was the least. It is safe to generalize then and say that one of the primary factors in curbing rapid advancement in wool manufacture was the almost complete dependence upon male skilled artisans.

Variable Raw Material

Another reason of like importance in restraining wool manufacture was the incessant change which faced all men who engaged in the business. In the first place raw material was seldom twice of the same quality. Wool fiber is greatly affected by the climate, the breed of sheep, and the soil over which the animals browse. If the climate is not even, but has a period of cold succeeded suddenly by a period of warmth, the portion of the fiber which grew stoutly in response to the cold weather is weakened in the succeeding warm weather and an almost perceptible joint occurs within the one fiber. Of course, the presence of this joint impairs the strength and lowers the value of the fiber in which it occurs. The distribution of rainfall, too, materially affects quality, as excessive rains wash out the protecting grease and extreme dryness causes an extra exudation of grease with consequent loading of the raw material. That the breed of sheep affects the quality of the fiber is at once apparent. Farmers have seldom taken care to select pure bred flocks so the fleece when sold is not uniform even within one flock. The places where the sheep graze modify the quality of the resultant wool, in that the color of the soil may change the shade of the wool or the nature of the soil in permitting the growth of certain poisonous weeds or the propagation of particular parasites may have a material influence over the wool on the back of the sheep. Since high-grade wool cannot be procured by hit-or-miss methods but is the result of painstaking care, it can be truly said that the shepherd and his dog are as fully effective agents in the production of fine wool cloth as is the superintendent of the mill where it is manufactured.

Tariff Changes

Not only is the raw material undergoing continual change, but also variations in the tariff cause the manufacturer to face repeated reorganization in adaptation to the inflow of particular grades of wool in some years and their exclusion in others. The relation of wool to the tariff is unique in that this commodity is the only one for which a special tariff act has been placed upon our statute books (1824). Since tariff interests three groups, namely, the farmers, the manufacturers, and the public, and since what is desirable for one group is a menace to the others, no wool tariff act has ever been generally satisfactory. If it pleased one group, by that fact it was sure to be displeasing to another; therefore, no tariff on wool has ever been of long standing, because the aggrieved groups have insistently urged a new act in their favor. Each shift has meant a novel set of conditions for the manufacturer in regard to his raw material and his finished product.

Caprices of Fashion

Still another cause for perpetual variation in the wool business has been its subjection to the caprices of fashion. The largest output of the wool factories is designed either for women's dress goods or for men's suitings. Both of these are outer garments and are never of the same cut, quality, or kind and amount of raw material, pattern, weave or finish, from one decade to another, or of late even from one year to the next. The styles of men's and women's clothing do not vary together, so a mill manufacturing for both markets must closely watch all the vagaries of each. A sudden veer of fashion may cause a complete overturn of all of the plans of a wool manufacturer and may require that he revise his entire manufacturing scheme from raw materials to the adjustment of mechanical appliances. Fashion can effect its revolution within a few months, but it may take years to recover the ground lost. For example, a shift from wool dress goods to mohair means reversal from the demand for fleece from sheep to a requirement for hair from goats. During the period when this fashion may be prevailing, flocks of sheep may be sent to the butcher because a part of its revenue return has been cut off. If at a later time a return is made to a demand for wool cloth it would take years to regenerate the flocks to meet the demands.

Unsteady Basis

The result of all the aforementioned factors is that wool manufacture is never upon a solid, steadfast basis. Since it is much easier and simpler to turn a small factory than a large from one kind of production to another, and also since the incessant variation has been the direct cause of so many failures that at any given time there have been within the industry a large proportion of new firms conducted unpretentiously as a rule, the typical woolmill until the middle of the nineteenth century was a small-scale affair. In 1840, the 1,420 woolmills of the United States had an average product worth $14,575. The fathers of the American wool industry, John and Arthur Scofield, whose efforts to establish the factory system in wool manufacture are comparable to Slater's activity in cotton manufacture, very well illustrated the latter point. These two brothers were interested successively in no less than five different wool manufacturing concerns during a score of years. These plants, all diminutive, were located at Charleston, Newburyport, Byfield, and Pittsfield in Massachusetts, and at Montville in Connecticut. Profitable, large-scale production depends primarily on standardization, a condition which has been entirely lacking in the wool enterprises of this country.

Worsted Wool

Considering then the active opposition of England's established trade, the lack of inventions of direct aid to factory enterprises, the inadequate quantity and poor quality of the raw material, and the incessant changes in fashion which called for ready adaptability, it is no wonder that the American wool industry did not progress to the same degree as the cotton manufacture and that at the opening of the Civil War our mills were at least twenty-five years behind those of England. Beginning with the Civil War and continuing to the present day, there has been a marked improvement. This effect is largely due to the introduction about 1860 of a new type of wool product, namely worsted cloth. Worsted differs from woolen cloth in that it requires a longer and coarser fibered wool and also in the requirement that the raw material be more carefully prepared for spinning. The woven cloth, too, is in quite marked contrast. A typical woolen cloth, such as broadcloth, is made from yarn so spun that it results in a soft, rather fuzzy product; when woven into cloth this yarn makes a material wherein the weaving is obscured. In fact, all cloth of this sort somewhat resembles the surface of a Brussels or Wilton rug. On the other hand worsted yarn is tightly twisted when it is spun so that the resultant product is smooth. This can then be woven into a cloth which shows clearly on its surface the method of weaving.

The first worsted cloth in the United States was made at Ballardvale, Massachusetts, in 1843. This first product was dress goods. It was not until 1867 that men's worsted suitings were manufactured. In fact, it was not possible to produce much worsted cloth in this country or anywhere else except England before the Civil War, because the British had a virtual monopoly on the manufacture of worsted yarn through the fact that they raised the most sheep which yielded the type of wool fitted for products of this character. The necessity for a great deal of combing of the raw material preliminary to spinning and the absence of any machines to do this work, together with the requirement of employing especially highly skilled, well-paid men for the job, effectually prohibited the manufacture of such material in this country. The manufacture of worsted yarn is ten times as arduous and complicated as the manufacture of woolen yarn.

Improvement Since Civil War

Just before the Civil War however a machine was invented whereby worsted yarns could be combed as successfully as woolen. The first worsted combing machine operated in the United States was placed in the Pacific Mills at Lawrence, Massachusetts, in 1854. That same year marked the beginning of the policy of reciprocity with Canada. So far as worsted manufacture was concerned, this was fortuitous because Canada at that time following the example of her mother country was breeding the variety of sheep that yielded the best worsted fiber. Another source of raw material was also opened to our mills by the invention of a cleaning device whereby the wools of Argentine, formerly too dirty to be valuable for manufacture, were made serviceable. These things, occuring simultaneously, enabled us to enter upon the manufacture of worsted cloth. The Civil War itself gave a decided incentive to this branch of industry through the needs of the army for uniforms. A worsted uniform, being smoother, was easier to keep clean and in good condition than a rough surfaced woolen one and for those reasons was more desirable. The more than a million men in the blue-clothed ranks taxed our manufacturing capacity to the utmost to supply the army needs, so that many cotton-mills finding their own raw material curtailed sought promised profits in a change to worsted. This war stimulus to worsted manufacture placed it upon a solid basis for further achievement.

Growth of Worsted Industry

Once started, worsted manufacture has developed certain characteristics which have favored its rapid progress. It permitted a large employment of female labor, for although there are more processes involved in worsted manipulation than in woolen, the intervention of machinery made these processes simple, light and easily learned. For that reason alone worsted manufacture has been able to reach proportions never attained by the typical male-employing woolen-mill. The agents for worsted mills moreover soon learned that there were certain cloths that could be counted upon as staples, inasmuch as they were demanded year after year, no matter what changes occurred in fashion. Such products as blue serge or black clay, and both blue or black unfinished worsted, and certain plaid goods can be classified as staples. Worsted yarn very closely resembles cotton and may be mixed with cotton so skilfully that even experienced men find it difficult to detect the adulteration. Coming in an age of declining supplies in raw wool, this fact has increased the importance of worsted cloth, a movement that has been intensified because the world shortage of wool is more generally of the fine varieties.

Unlike the former woolen business, the modern worsted industry closely resembles cotton manufacture. Like cotton, it is dependent upon machinery; analagous to cotton, it employs a large number of women; and similar to cotton it possesses products that may be called staples. Consequently, instead of being conducted upon a small scale in widely scattered plants, the worsted mills have from the first tended toward large scale production with the plants concentrated within relatively narrow areas. One of the localities where worsted is largely manufactured is that near Boston. This is partly the cause and partly the effect of the fact that Boston is the second largest wool market in the world, only London surpassing it at the present time. The largest woolmill in the world is located at Lawrence, Massachusetts. Another region devoted to this type of material is that in and near Philadelphia. The following tables set forth the number of mills and the capital employed in the worsted and wool manufacturing industries in the years given:

WORSTED MILLS

Year	Number	Capital
1860	3	3,000,000
1870	102	10,000,000
1880	76	20,000,000
1890	143	68,000,000
1900	186	132,000,000
1914	298	281,000,000

WOOL MANUFACTURE

Year	Number	Capital
1849	1,559	28,119,000
1914	501	134,597,000

Relative Scarcity of Wool

At the present time the principal problems that confront our woolmills are the increasing shortage of raw material and the consequent increasing use of substitutes. There is not only a relative scarcity of raw wool in the world, but the amount is actually decreasing. The relative shortage is due to the adoption of wool clothing by many more peoples than formerly used it. First appearing as a typical temperate zone, western world product, it is now common even in the tropics and the Far East. Notably, the opening of China and Japan to the influences and habits of the western world has stimulated those countries to forsake their customary cotton garments and to accept woolen clothing such as in worn in Europe and America. In the United States the per capita consumption of wool has increased from 3 pounds in 1790, to 4 pounds in 1850, and to 8 pounds in 1900.

Since the general increased world demand for wool has not been met by an augmented world supply, we are now facing a relative shortage in the raw material. On the other hand the actual decrease in raw wool is due to the fact that sheep may be bred for more than one purpose, namely, they may be as valuable for meat as they are for their fleece. As long as the ends of the world were inaccessible because of difficulties of transportation, such places tended to send into the stream of commerce only commodities of a high value which could be packed into a small space, easily carried on the backs of men, burros, or llamas, and which would keep without marked deterioration for a long period. The two marketable articles that best fitted all these conditions were wool and hides. Places such as the tip end of South America, or the extremes of Africa, or the remote inland mountain districts of Tibet or Turkey, sent to the outside world by devious means the wool of the sheep that were raised in those districts.

Refrigerator Ships

But the invention of refrigerator ships, the extension of steamship lines, and particularly the opening of formerly inaccessible regions by railroads have made it possible for places like the pampas of Argentina, far outside the centers of population, to turn attention to raising animals for the world's meat supply rather than for the sale of wool or hides. The hunger of the East-End Londoner is now felt and partially relieved by the sheep ranches of Patagonia. But in order to furnish nourishment, the shepherds have changed their breeding policy. Instead of breeding sheep primarily for the production of high-grade and large quantities of wool, the modern fold master selects animals that yield some profit from a smaller amount of lower grade wool, but furnish a larger money return because of the enhanced value of its carcass for meat. His choice is dictated by some such computation as this:

	Wool Worth	Carcass Worth	Total Return
Pure-breed wool sheep........	$5.95	$8.40	$14.35
Cross-breed meat sheep.......	5.05	11.20	16.25

In consequence of the fact that the world has turned to cross-breeds and away from pure-breed wool sheep, we are now suffering from an actual decrease in the quantity of wool produced and from a much greater falling off in the quality of wool grown.

Shoddy

This relative and actual decrease in the amount of wool in the world led first of all to making the fullest use of all the wool there was. In 1850 wool rags were worth only $20 a ton and were more frequently sold for manure than for any other purpose. Within twenty years the pinch for wool began to be felt so that rags were then sold for $200 a ton and were being reworked in wool manufacture. This was the beginning of the very much derided shoddy business. Shoddy is wool cloth manufactured by taking worn wool rags, shredding them into their original fibers and then respinning and reweaving them into new cloth. Since the fibers are necessarily weakened and shortened by their first wear, shoddy is consequently not as high grade as the original wool cloth, but the demand of the world for wool is so far in excess of the supply that if it were not for the presence of shoddy a good part of mankind would have to go through the winter either naked or cold. Under the present conditions wool is not only used twice, but frequently passes back to the shoddy-mills a half-dozen times. A wool fiber may make its first appearance in a $100 custom tailored suit, but be finally worn out as filling for a horse blanket.

When shoddy was first marketed in this country its chief uses were for stuffing horse collars or furniture and for "filling" other wools. Then shoddy was employed as a backing for suitings whose face was of better wool. Today, partly due to more acute scarcity and partly to better manufacturing methods, shoddy supplies a valuable raw material for clothing, manufacturers specializing in the cheaper varieties. The only detraction concerning shoddy is when it is passed off as superior wool; this is an unwarranted deception and should be prohibited. The whole business of collecting rags, sorting, distributing, and remanufacturing them is as well organized as any other branch of wool manufacture. In 1914 nearly $8,000,000 worth of shoddy was manufactured in the United States.

Substitutes

But the full use of wool does not fully meet the demands for the world's clothing. Therefore for much of its wearing apparel the world has had to seek substitutes.

There is a great deal of what economists call "elasticity of demand" in the purchase of clothing. Although wool is highly desirable for this use, there comes a time when increasing price for that type of clothing enforces men to seek some other form of protection against the weather. In other words, men will use wool so long as they deem the price reasonable, but just as soon as the price goes beyond this point men will utilize a different material. Fortunately in the United States climatic conditions enable us to turn to substitutes for part of the year at least, not only without discomfort, but actually with a greater degree of bodily health and a much closer adaptation to environment. It was not until wool became high priced that men could be persuaded to discard woolen clothing during our hot summers. But of recent years the hard compulsion of necessary economy has forced us to adopt the fashion of wearing cotton, linen, or silk clothes during June, July, and August. Such cloths as those advertised under the trade-name of "Palm Beach" and its host of imitators, and such suitings as the Shantung silks, are a real forward step in the adaptation of our American life to our American environment. We have been compelled to make this advance whether we wished to or not by the ever mounting price of wool clothing, due in the first instance to actual lack of wool.

We have traced wool manufacture through its traditional age-long association with the welfare of mankind, through the era of household manufacture during the colonial period to the halting restricted attempts to establish the factory system before the Civil War. The later progress made with a new wool material, worsted, has also been pointed out as well as the modern problems arising from a world scarcity of wool.

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CHAPTER VIII

THE LEATHER INDUSTRY

Leathers and Tanning Agents

To anyone for whom the spectacular has an appeal the leather industry offers rare satisfaction, for in the search for suitable raw materials men have explored the animal, vegetable, and mineral kingdoms and have subjected to treatment the hides or skins of beasts, birds, and fish. As tanning agents the brains, oils, and fats of animals have been used; the woods, barks, leaves, fruits, roots, and even the larvæ of parasitic insects or the diseased portions of plants have been made to yield tannic acid; and minerals, from alum or iron to common salt, have been tested to determine their fitness as preservatives. Notwithstanding that the hides or skins of all the common domestic animals have formed the basis for leather, the hunt has been extended also into the wilds, and the hide of the elephant and buffalo or the skins of antelope, deer, kangaroo, and even rabbits have been brought back to the tannery. The ocean too has furnished its share to the industry in the skins of seals, porpoises, walruses, and whales, while the fresh water, back country ponds have been dragged to give up their humble frogs in order that the leather business should not lack for materials. Lizards, crocodiles, alligators, and snakes have at times contributed supplies to the tanner's art. Even the birds have suffered the same fate for ostrich and swan-skin leathers are not unknown, and during the Elizabethan period chicken skin was quite a favorite for gloves or beauty-masks worn at night—much as rubber masks now are sometimes employed—to remove wrinkles or reduce double chins. Man's own skin has been manufactured into leather. During the French Revolution it is recorded that each day's horrible crop from the guillotine was taken to the town of Mendon and there the skins transformed to leather, the roll of the carts coming in from Paris at night sending a shiver of abhorrence through the citizens of Mendon. In godly Massachusetts, at the town of Tewkesbury, it is said that the bodies of dead pauper children were made to contribute leather for local shoe manufacturers until the practice was prohibited by law.

Wide Variety

From reptiles to man, from roots to fruits, well-nigh every living thing has at some time in some place been made to fill the need for leather. Savages and civilized men alike have found in leather the material most readily adaptable to a wide variety of uses ranging from clothing or house furnishings to tools, weapons, and musical instruments. Since leather has been so essential everywhere to human beings in all grades of advancement, it has been manufactured from the materials closest at hand; this in part accounts for the amazing variety of substances employed. Another part of the explanation is that the name "leather" covers an array of distinctly different things. A sealskin card-case and a steer-hide shoe sole are both "leather" but card-cases cannot be made from steer hide nor soles from sealskins; likewise there is just as much individuality about book bindings and factory drive-wheel belts although both are called "leather." In short, there are many sources of leather because there are many uses for it each demanding certain unique qualities.

Two Standard Leathers

Yet, after all, the principal raw materials are few in number, a paradox that is made clear when it is understood that there are only two standard leathers and that these comprise all but a very small amount of the total quantity of leather manufactured. The host of special varieties form a distinctly small portion of the world's output of leather. The case is somewhat analogous to a classification of all men into those that are honest and those that are criminals. Since most men are honest they are alike in that respect but the small minority of criminals differ most strikingly in their criminality. The two standard leathers may be called heavy and light, or sole and upper. Heavy sole-leathers are generally made from cattle or horse hides while the light upper leathers are derived from the skins of calves, goats, sheep, or pigs. Heavy leathers are made almost entirely by tanning with the bark and wood of oak, hemlock, or quebracho while light leathers, once made the same way, are now more often manufactured by a mineral process. To this generalization there are some minor exceptions; for example, Great Britain, lacking the forests of the Americas or Central Europe, imports a variety of tanning materials ranging from the nibs of acorns to Italian sumac while France, a specialist in high-grade light leathers, forsakes in many of her plants the technical "tanning" process and adopts instead "tawing," changing the skins to leather by means of oils, or combinations of fats, albumens (eggs), and oils. In the main, however, the tanning industry as we have stated is supported by hides or skins transformed into leather by bark tans.

Tan Bark Transportation

Since tan-bark and hides (or skins) are seldom found in sufficient quantities in the same locality, one or the other must be moved to the point of leather manufacture; consequently transportation is a vital element in the industry and has had a marked influence upon it. At first hides were carried to the bark, then extracts were made from the bark and shipped to the place of origin of hides, but of late both materials have been sent to cities within easy reach of the market.

Although bark is relatively light in weight, it is bulky and difficult to handle and rapidly depreciates in quantity and quality if it is moved for any distance. It breaks easily and its tanning content is easily leached away if the bark is exposed to the weather, and because of its bulk it cannot be stored cheaply in large quantities where land values are high. Bark therefore has never been transported very far from the forests.

Carriage of Hides

Hides present an entirely different transportation problem. They can be preserved by simple drying in the sun, or by dry salt, or by pickling in brine. When preserved their ratio of depreciation is much smaller than that of many other materials. They can be carried over the roughest roads by the crudest means. Their value is so high in proportion to their bulk that they can profitably be carried all the way around the world. As a result they have always been a great trading asset for economically retarded nations, or countries difficult of access. Hides are brought together from the interior of Russia at the annual fair in Nijni Novgorod, 275 miles from Moscow, and goat skins from the heart of China are collected at the ports of Shanghai and Hong Kong.

Likewise the remote eastern front of the Andes can keep in touch with the outside world through packs of hides toilsomely carried over the mountains to the nearest western ports. From South Africa, inland Portugal, upland Spain, and mountainous India, hides trickle into the side streams of trade and finally reach the great floodgates of commerce. So long as transportation was confined to waterways, hides were moved to bark, and tanneries were always back-woods projects. The coming of the railroad, however, has brought a change to the whole cattle business and has had a marked effect on the leather industry.

Meat as By-Product

Before the era of railroads when cattle were raised chiefly for their hides the meat could be consumed only on the ranch itself, and since the meat-eating capacity of any ranch was strictly limited, hundreds of steers were slaughtered without any use whatever of the flesh. During the twenty-five years after 1800, cattle were driven overland from Ohio to eastern seaboard markets—notably Baltimore—to be sold for meat; but this trade, though profitable, was wasteful of meat because the animals lost so much weight upon their journey. The business could be supported only by the cheapest food grown on the cheapest land.

The development of railroads has reversed this situation; meat is now the valuable product with hides the by-product. Railroads permitted cities near the grain district to specialize in slaughtering, so that the animals could be killed at the points where they were of maximum weight and yet fresh meat be sent to the great eastern cities. Chicago, of course, became the greatest of these slaughter-house centers.

Chicago stock-yards introduced two factors that were new to the leather industry; first, they made hides secondary to meat as we have said, and second, they collected at one spot a great quantity of hides, whereas always heretofore hides had been gathered a few at a time from widely scattered ranches or farms. The first of these factors has made tanning a gambling business while the second has shifted the location of tanneries.

Speculation in Tanning

Tanning has always been a highly respectable trade because it presupposed relatively large capital or excellent credit. Since it took from six months to a year to convert a hide into leather, the turnover of money was so slow that no man with small means could enter the craft. In many cases the business was hereditary, families for generations being known as tanners. As long as hides constituted the principal revenue from cattle, the price varied according to the direct needs of the tanners and the supply on hand. The price then was a fairly predicable figure and notwithstanding the fact that the element of risk necessarily accompanied a business in which returns were slow, tanning was not highly speculative. On the other hand, when meat became the chief interest of cattlemen the price of hides bore very little relation to the tanner's demands or supplies but was largely determined by the market for meat; tanners had to be good guessers or trust to luck. This has introduced uncertainty into the trade and the real business of tanning is often subsidiary only to "playing the market."

Tanning Extract

Centralized packing-houses not only rendered tanning a speculative industry but the stock-yards piled up great supplies of hides all in one convenient spot. The conventional method of shipping hides to bark was based on scattered sources of hides and uneconomic transportation of bark; but with stocks of hides accumulated at Chicago, attention was called to the need for improving the method of carrying bark so that the tanning could take place at the source of hides. Even though, as noted above, the ratio of deterioration in hides is relatively low, it is nevertheless considerable; in fact hides often lose half their value before their arrival at the tannery. Hence a method that would permit tanning without moving the hides was highly desirable. This end was accomplished by soaking from bark the tannin it contains, then concentrating the extract and transporting it instead of the bark. This procedure not only utilized the hides where and when they were most valuable but it gave better leather as it was easier to standardize extracted tan liquors than to get definite results in the old bark-pits.

Under the old system, too, the tanner was limited to the three or four materials obtainable nearby, but with extracts he had his choice of twenty and could blend them to get any desired result. The known tannin content of extracts saved time in producing leather, and the ease of handling the extract permitted economy of labor. Inasmuch as one barrel of extract was the equivalent of one cord of bark taking up 128 cubic feet of space, the storage room necessary for extracts was only a fraction of that required for bark. These advantages were too great to be overlooked and a ring of tanneries was drawn around Chicago, some in Illinois, some in Michigan, and some in Wisconsin. The leading center is at Milwaukee, Wisconsin. In 1914 that city produced more heavy leather (6.2 per cent of the total produced in the United States) than any other city in the country.

"French Kid"

Until about 1890 our large forest resources in oak and hemlock and our supply of coarse cheap hides enabled us to produce heavy leather to good advantage, but for the high-grade, light-weight leathers made mostly from kid skins, we were forced to look to France. We raised but few goats commercially and our tanneries, located in reference to bark, were poorly equipped to turn out leathers made by oil, fat, albumen, or alum processes; "French kid" as a consequence poured into this country at the rate of $10,000,000 worth a year. Then came the Franco-Prussian War of 1870; our supplies of French kid dwindled to almost nothing and kid shoes rose to $12 and $15 a pair, offering a direct challenge to our tanners to produce a substitute for the light French leather. Since the old methods were of no avail, attention was necessarily turned to new processes.

Mineral Tanning

Although tanning is essentially a chemical problem, chemists paid no attention to it until after 1890; previous to that time tanners operated by rule of thumb or, as one put it, "by guess and by gosh!" Tanning consists in combining a preservative material with the gelatinous matter of the hide in such a way as to prevent rapid decay. The age-long material for this purpose has been the astringent tannin found in many plants, shrubs, and trees; but about 1890 chemists began to suggest that the same results could be obtained by various mineral compounds notably those of chromium, iron, aluminum, or soda. The scarcity of French kid after 1870, and the necessary demand for a light leather, caused tanners to heed these hints; however, when experiments were made, it was found that although the mineral processes produced leather it was too hard and brittle to be of any practical use. Nearly every experienced tanner balked at this point and refused to experiment further.

The credit for discovering the secret of successful mineral tanning belongs to Robert H. Foerderer of Philadelphia, who in 1888 conquered the difficulties that beset him, and put on the market a chrome-tanned, light-weight leather that he called "vici kid." After Foerderer pointed the way, mineral tanning became immediately popular. It supplied the dearth of light upper leather and completely swept out of our market, and kept out, imported leather of similar character; we even exported chrome leather to France. At the present time most of our light leather is made by the chrome process.

Location of Tanneries

The introduction of chemical tanning brought new elements into the leather industry; it used a new tan agent and was most effective upon a new variety of skin and the business prospered in a location new for tanneries. Goatskins, the principal raw materials for chemical tanners, are not produced in sufficient quantities in the United States to supply our tanneries, so the bulk of our chemical tanned leather is manufactured from imported skins. This fact makes a port city the most favorable place for the erection of a plant. Inasmuch as the business started in Philadelphia, that port has witnessed the greatest growth of this branch of the art; in short, the Delaware River Valley from Trenton to Wilmington, with Philadelphia the principal center, produces the most chrome-tanned leather in the world. In Massachusetts and New York City the influence of nearby markets in the shoe factories has led to the establishment of a number of chrome tanneries.

Growing Scarcity of Hides

The change from vegetable to mineral tanning was not so revolutionary as the situation that confronts the tanners at the present time, namely, the threatening substitution of artificial leather for the real thing. For a long time American tanners have enjoyed unusual privileges and opportunities because our country has been so wealthy in the resources essential to the tanning industry. Our forests have furnished abundant supplies of tan-bark, while our vast area of free grazing land has promoted an extensive cattle business. But the day of plentiful raw material is over. The forests have been depleted to such an extent that we have had to learn rigid economy in tan-bark, forcing us to make a close study of the chemistry of tanning, in order that every bit of effective tannin might be utilized. We have had to go further and either import new tannin-bearing material such as quebracho from Argentina or place greater reliance upon mineral and animal tanning agents. The threatened shortage of tan-bark, however, is by no means so serious as the increasing scarcity of hides.

Disappearance of Ranching

Of the beef animals of the world 55 per cent are in the Americas, North, Central, and South, so that any changes in the animal industries of these three countries will surely upset the leather business of the world. Our western plains and the similar area of Argentina contain more cattle per capita and per square mile than any other place in the world. Unfortunately for the continuance of cheap leather ranching is a declining occupation in each of these two regions. The free grass areas were first contested by the detested sheep herders and then by the bona fide farmers. Much of the former range was put into farms and what was left had to be fenced into corrals, a much more expensive method of producing cattle products, than free grazing on public lands. In 1907 there were in the United States approximately eight cattle for every ten men, women, and children, but by 1915 there were only five animals for every ten people. The decrease was actual as well as relative for the number of cattle declined from 70,000,000 to 58,000,000. Furthermore, the farmers have turned from beef animals to dairy herds, and the ranchers have been forced to improve their breed of beef stock. Both these changes have tended to increase the price of leather by decreasing the number of first-class heavy hides. In any given number of dairy cattle more bull calves and worn-out cows are slaughtered than in an equal number of range animals. Because their hides are thinner and more "spready" it happens that neither calves nor cows give as valuable hides as steers; consequently, in so far as our farmers take up dairying just so far is the number of heavy hides reduced.

Quality of Hide Lowered

From a different cause but with the same effect, the changed attitude of cattlemen toward breeding reduces the stock of sole leather. Since wild cattle have the thickest hides and the highest bred beeves the thinnest, it follows that whenever ranchmen turn attention to improving breeds they aim a blow at the best grades of leather. England with its blooded stock long ago gave up using domestic hides for sole-leather and went instead to the unimproved herds of Portugal or Spain for supplies. We formerly depended on the wild Texan cattle for our sole-leather hides; but Texas, like all the rest of the cattle country, is more interested in high-grade beef than in top notch leather. Our resort to Argentine hides will not suffice us for very long because the incentive there is also toward meat production, not hides.

On both the farms and the range, the modern methods of feeding, especially in the winter, tend to lower the quality of the hide for leather purposes. Wherever oil cake of any kind is fed to cattle, their hides become greasy and weak fibered. The practice of cake feeding is so extensive and the result so universally bad for the tanner that the price of hides taken from cattle that have been fattened in this way is reduced 50 cents per pound.

Scrap Leather

So acute is the resultant scarcity of sole-leather material that every scrap of it is used and many pieces over and over again. In fact, the collection and distribution of scrap leather has become one of the most thoroughly organized branches of the leather industry and the scrap dealer is a useful and economic member of society in general as well as a valuable adjunct to his own trade. Splitting machines that will divide a hide accurately into two to five pieces have been perfected so as to make every hide go as far as possible. In order to keep as much as possible of our waning supplies of heavy hides in our own country, our big packers insist when live animals are sold abroad that the hides be returned to the United States. Congress, in 1907, recognized the shortage of hides in America and repealed the duty on imported supplies.

Increasing Use

The scarcity of heavy hides would not be so serious if the demand for sole-leather was not every day becoming greater. Leather house furnishings, from grand-father's chair to library wall coverings or picture frames are very popular; leather trunks, bags, and suitcases were never more desired; cases for guns, fiddles, golf clubs, and safety razors are all made of leather, to say nothing of automobile seat coverings and tops which take two and a half hides per car. No one needs to be convinced that sole-leather is in great demand for innumerable things beside shoes.

Substitutes

Smaller supplies with which to meet an increased need can have but one result; substitutes must be found. One variety of substitute has been on the market for some time. This is a fabric impregnated with leather-like substances and sold to replace leather for upholstery, art objects, and toilet articles. It has the advantage of being manufactured in standard lengths, widths, and qualities but has the disadvantage of a peculiar odor something like oilcloth. A different substitute has been tried out in the engineering field; instead of leather power-transmission belts we have turned to rope, wire, and web devices. But until recently there was no substitute for leather for shoe soles.

Manufacturers have been experimenting for several years to find something that would take the place of leather for footwear. Woven rope alone, and woven rope impregnated with a waterproofing substance, fibrous materials compacted like cardboard, mixtures of scrap leather and rubber, all these have been tried but without much success. By shutting out imported raw hides and by greatly increasing the demand for leather, the Great War stimulated the spirit of invention. Rubber manufacturers were the first to seize the opportunity and flooded the market with fiber compounds to replace sole-leather. The high price of leather kept these substitutes relatively costly, but with increasing competition and improved methods of manufacture the price ought to fall. These substitutes will probably crowd leather from the shoe sole market and may invade other domains of sole-leather such as the trunk, suitcase, and bag business.

Upper Leather

In like manner but to nowhere near the same degree leather for uppers is becoming more scarce and higher priced. Goatskins, used primarily as the raw material, were curtailed by the war and it will take years for the supply to catch up with the demand, if it ever does at all. Furthermore, the exhaustion of sole-leather puts a greater pressure on upper stock so it is only a question of time when a substitute for upper leather must be found. Felt might be used as a shoe upper material except for its poor wearing qualities, so a woven fabric of some sort probably will be the solution of the difficulty. A very fertile field for investigation along this line is an artificial leather made with a minutely-woven fabric base impregnated with gelatinous or albuminous matter. Since most fabrics except silk or wool are derived from plants there need be no fear of shortage of supply. At any rate it seems probable that the not distant future will witness some kind of a light, artificial leather.

The day of artificial leather does not necessarily spell doom to tanners because leather has a great many uses not touched by the substitutes, and in addition many people like leather for itself; they would not accept anything else unless the price of leather were prohibitive. The presence of substitutes relieves part of the burden on the leather industry and by so doing, enables the price of leather to be kept within reason. Consequently artificial leather may be more of a benefit than a harm to the established tanning industry and probably there will still be a market for all the leather that can be produced.

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CHAPTER IX

THE SHOE INDUSTRY

LEATHER SHOE INDUSTRY

The Cobbler's Standing

There are few American industries more absorbing than the manufacture of shoes. Human interest has permeated it from the arrival of Thomas Beard and Isaac Rickerman in Salem, Massachusetts, in 1629, down to the latest recruit in a modern factory. Shoemakers both in America and Europe have always held an exalted place in the esteem of their fellowmen. Inasmuch as shoemaking was a sedentary, noiseless, well-nigh mechanical task giving plenty of opportunity for the craftsman to mull over politics, religion, or philosophy either by himself, in company with his fellow-workers, or with his customers, the shoemaker's shop has always been looked upon as a clearing house of opinion and it is but natural that many a bench-warmer has risen to seats more eminent. St. Crispin, the patron, whose birthday, October 25, was celebrated for years by the craft; George Fox, the founder of the Society of Friends; Roger Sherman of Connecticut and Francis Lewis of New York, signers of the Declaration of Independence; Mad Anthony Wayne, almost legendary revolutionist; Nathan Tufts, founder of Tufts College; Henry Wilson, eighteenth Vice-President of the United States—all these were at one time in their lives humble wielders of the awl and waxed thread. Only the printers' trade has given more men to fame than the shoemakers'. The traditionary standard of this trade called "The Gentle Craft" was not sullied in the little towns founded by our ancestors, where the cobbler usually was a man whose opinions had weight in the community.

Errant Shoemaker

The shoemaker's handiwork was limited to his own locality because he had to depend on the neighboring farmers for his supply of raw material, a most uncertain source. There was no definite place from which he could secure leather in large quantities at all times. He was equally restricted as to a market for finished wares, since there was no way to ship large numbers of shoes except by horseback or wagon, methods which were prohibitive by reason of their cost.

Some shoemakers, especially those near the frontier, fared forth regularly from their town shops to travel through all the outlying country districts in order to make up shoes for settlers' families right at their own homesteads. The farmers cured and tanned the hides required for raw materials and then waited for the wandering artisans to come to their doors. The errant shoemakers were welcome visitors long awaited at frontier clearings. The tools requisite for shoemaking were extremely simple and easily portable: a lap-stone, a hammer, variously shaped awls, and a shoulder stick were the only ones necessary, while an apron and some waxed thread completed the equipment. This simple outfit had not changed since the time the Egyptian pyramids were built, a fact proved by inscriptions. Skill was the one great asset of a shoemaker and although it took ten to twelve years' apprenticeship to acquire it, once possessed, it could be applied as well in one spot as in another.

The errant cobbler or the fixed local shoemaker within the towns were familiar figures in every American community, and the industry was everywhere local; that is, it depended upon raw materials, labor, and market all in the same neighborhood.

The City of Lynn

In common with all other villages, Lynn, Massachusetts, had its own shoemakers, beginning with Philip Kertland in 1635; but whereas other towns had only a cobbler apiece, Lynn eventually became the seat of a shoe industry of considerable size. A combination of circumstances gave Lynn advantages that no other town enjoyed and enabled her to forge to the forefront in the manufacture of shoes.

The natural outlet for the energies of Lynn's people was the sea, for the town is half-way between Salem and Boston, the two principal ports of colonial New England. It was accident that turned Lynn citizens from becoming sailors and instead made them shoemakers. By chance, a Welsh immigrant named John Adam Dagys, a shoemaker of great genius, settled in Lynn. Dagys—his name is sometimes written Daggs, or Dagyn—was by no means the first man of his trade to arrive in Lynn but he differed from all his predecessors in that he was a man with a great idea in addition to being skilled with his hands. His idea, now commonplace but at his time an innovation, was the application of the principle of subdivision of labor to the art of shoemaking. Discarding the age-long method of production by which one man made one shoe completely from start to finish, he substituted the method by which each worker specialized upon part of a shoe and did that work exclusive of all else. In addition to revolutionizing the organization of the processes of manufacture, Dagys also made the product more suitable for its market. Shoes well adapted to the settled conditions of Europe were ill adjusted to the pioneer state of the new world, so Dagys imported samples of the English and French art, dissected them, found where they were faulty, and then cut out and sewed together new shoes without the flaws of the foreign-made articles. Since the American shoes so devised were simpler and stronger than the European, they were better accommodated to a system of subdivision of labor, for almost anyone could learn to sew together the few individual parts of which they were composed.

Work at Home

Once the idea of subdividing labor upon a shoe was accepted, the situation of Lynn lent itself to the rapid adoption of the system. In the making of a shoe a much larger number of workers are required for sewing individual pieces of the leather to linings, and then binding the pieces into one complete unit to form the upper part of the shoe, than are needed for cutting out and preparing soles or joining uppers and soles together. Furthermore, since the work upon the uppers is light and easy to perform, it is well adapted to female labor. Fortunately, in the vicinity of Lynn there were a large number of women eager to add to the family income by moderate tasks of this nature. In the famous fishing towns of Gloucester, Beverly, Salem, Marblehead, and Boston, the wives, daughters, and sisters of men absent on long cruises were delighted with work that gave them an immediate, substantial return. Hence, after the introduction of the Dagys system of manufacture, there was hardly a fisher's cottage along the shore north of Boston that did not have some female member connected with the shops of Lynn working, however, in their own rooms. Lucy Larcom, the New England poet, has made this feature of the shoe industry memorable through her poem "Hannah Binding Shoes." Lynn and its neighboring towns on the coast were ready for an industry that would give employment to their people, and Dagys, by splitting the art of shoemaking into small parts, each one easily learned, filled a long-felt want and started the north shore of Massachusetts upon a career of shoe manufacture on a scale nowhere else attempted. By 1795 there were 200 master workmen and 600 journeymen in Lynn alone, and the output of shoes per year reached 300,000 pairs.

Supply of Raw Material

After the impulse given to the shoe industry by Dagys had developed a business of considerable importance, two other special advantages that Lynn had over other communities began to appear; namely, she was never hampered by lack of raw materials or markets. Lynn was able to secure all the leather she needed from the vessels which made nearby Salem their home port or which carried hides into Boston, Lynn's next-door neighbor. That the harbors of Massachusetts Bay should gain early supremacy in commerce was due partly to a fact that is often overlooked, namely, that the roadsteads were open all the year round whereas the Hudson and Delaware rivers were closed by ice. In the leather business this condition deflected large shipments of hides that otherwise would have entered at New York to the harbors about Boston. To her position near these open ports Lynn must largely attribute the growth of her shoe business. Hides from California, Central and South America, and New Orleans; rosin gum (for waxing the threads) from the Carolinas; thread from Florence; and goatskins from Europe and Asia, all were heaped in profusion on the wharves at Salem or Boston. The hides and skins were converted into leather at Peabody and other towns adjacent to Lynn. With skilled workmen at home and with plenty of raw material at hand, it is no wonder that the shoe business developed at Lynn faster than anywhere else; especially since a market for the product was readily available.

It is interesting to note the changes in the sources of supply. Today the leather for uppers are obtained from India, Turkey, and Mexico, and are tanned in Philadelphia, or Salem; whereas the hides for soles are obtained from Chicago or Argentina, and are tanned in Tennessee, Wisconsin, or Massachusetts.

Export Trade

The first cargo of shoes sent out of Boston was carried in the sloop "Delight" which sailed for New York in May, 1818. The same vessels which carried hides to Massachusetts took back on their return voyage the shoes made from those hides, shipped in flour barrels like crackers, packed 75 to 100 pairs per barrel. It was not until 1840 that shoes were packed in special wooden cases and not until after 1850 that each pair was put in a separate box. In "Two Years Before the Mast" Dana described how eagerly the Mexicans, who then (1840) owned California, paid $11 for shoes that sold for $3 at Lynn, and made from leather that came from San Diego and which, consequently, traveled twice around Cape Horn. Lynn shoes were also worn on the plantations in the West Indies and in our own southern states, so a market was not lacking to the little shops in the thriving Yankee town. Danvers—north of Lynn—specialized upon heavy, cheap shoes called "brogans." These were sold entirely upon southern slave plantations. Since labor, raw material, and market were all brought together at Lynn it is natural that the city should slowly attain the leadership in shoe manufacture. The introduction of subdivision of labor, therefore, brought about a great revolution in the shoe industry, for it converted an art which had always been practiced in a purely local way in every community into a great industry centered in one narrow region around one town.

Other Shoe Centers

The fame of the Boston district for shoes, however, does not rest entirely with the towns along the north shore, for from the time of the Revolution the south shore too has come in for a full share of the prestige. This section had all the advantage in the procurement of raw materials or the disposal of the product that Lynn could claim; it needed only a start to set the industry in motion. That impulse came at the close of the War of Independence when returned Yankee soldiers, who had been taught shoemaking by the British, took up farming in the neighborhood of Randolph and as an odd-time job added shoemaking to their agricultural occupations. The shoes thus manufactured were exchanged at the nearest store for household supplies. Many of the storekeepers gradually drifted into functioning as wholesalers or commission merchants, and later became manufacturers controlling from a centralized point a scattered labor force on the farms of the neighborhood. The storekeeper-merchant-manufacturer bought the raw materials, sometimes cut it up into parts, distributed these to the farms, collected finished shoes, and disposed of them through Boston or Providence.

At first no south-shore town monopolized the business for it was important in a dozen. Shortly before the Civil War, however, two or three families, notably the Keiths, moved into Brockton and by their unusual zeal and business acumen, raised their town above all its neighbors in the making of shoes. The great demand for army shoes during the Civil War placed Brockton firmly upon the pinnacle of leadership among the south-shore towns, and in fact enabled Brockton to contest first place with Lynn. In 1900 Brockton wrested the crown from Lynn, but in 1910 Lynn snatched it back. Again in 1914 Brockton was the premier shoe town of the United States.

Interesting Distinction

There is one important and interesting distinction to draw between Brockton and Lynn; namely, Lynn and the north shore in general have always specialized upon women's shoes, whereas Brockton just as persistently has manufactured men's shoes to the exclusion of all other kinds. Along the north shore, inasmuch as the communities were interested principally in fishing, there were many women but few men available for shoemaking; as a result, the favorite type of work was that of a light variety which women could most easily perform. Since the preponderance of women was a permanent feature of this district, the manufacture of women's shoes also became stabilized. The influence of an early start had its bearing also, for Dagys was particularly skilled in manufacturing women's shoes. The south shore, on the contrary, due to the fact that it had few good harbors, never equaled or contested the north-shore fishing fleets but instead turned attention predominantly to farming. The men were home all the time and could do the heavier work required on men's shoes. Moreover the originators of the trade in this area having been trained as shoemakers while in the army necessarily were most adept in the making of men's shoes. Since the chief bread-winners of the families were never away from home for protracted periods there was no need and no time for the women of the household to seek accessory income from by-time jobs. So there has always been the marked division in handicraft between the towns north of "The Hub" and those south of it. This is shown in the following table:

WOMEN IN SHOE INDUSTRY[1]

Place	Percentage of Women to Total Employed	Product Typical
Lynn	41%	Women's shoes
Worcester	41	" "
Danvers	40	Children's "
Marblehead	40	" "
Boston	40	Women's "
Salem	38	" "
Beverly	38	" "
Marlboro	34	Men's, boys' "
Hudson	33	" " "
Milford	32	" " "
Weymouth	28	" " "
Rockland	28	" " "
Brockton	26	" " "
Natick	18	" " "

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[1] Massachusetts Bureau of Statistics, 1910.

Boston's Banking Supremacy

Both Brockton and Lynn benefited by their close relation to Boston in that Boston was the chief financial center of the country at the time the shoe industry was developed. Boston financial institutions had branch agencies throughout the South and West and most of the notes, mortgages, and checks from these regions passed through the Boston banks. Since the principal markets for Massachusetts shoes were in the South and West, and since all shoes were sold on six, ten, or twelve months' credit, it is apparent what an advantage it was to Lynn and Brockton to be so conveniently located in proximity to the Boston credit experts and money marts.

Boston was not only the banker for the South and West but also a great wholesaler. Groceries, drygoods, and hardware all passed over the Boston wharves en route to Philadelphia, Savannah, Charleston, Cuba, the West Indies, South America, the California coast, and Australasia. In 1810, 10 per cent of all boots and shoes sold in Boston were for export. The same articles from the same source traveled over the river highways to the inland western frontier. Nothing was easier than to include shoes also in the shipments of goods that were going forward from New England. A big factor in this wholesale trade was the large number of New England emigrants who settled the new sections and who naturally maintained trade relations with their old homes. The establishment of business houses, both wholesale and retail, in the pioneer districts was closely bound up with Boston's banking supremacy. The Yankee shoe trade followed the Yankee emigrants and these were influential in maintaining or extending the fame of Yankee shoe shops. By 1828 the total sales of shoes by Boston jobbers amounted to $1,000,000 per year; by 1856, this first million had been multiplied fifty fold for one year's transactions. Beginning in 1829 Boston wholesalers gave up consigning shoes to merchants, a method used to introduce them in new markets, and insisted that buyers come to Boston. Of course this added to New England's prestige. At the opening of the Civil War no other single American industry, not even the cotton-mills, employed as many hands as the shoe shops of New England.

Standardization

By making so many pairs of boots and shoes the Bay State artisans learned secrets of the trade unknown to craftsmen with a smaller output. For example, most boots made by the latter, although made to order, were very poor in fit. In fact usually they were so tight that the toes and heels of the wearer's stockings had to be soaped in order to get the boots on at all, and corns were actually believed to be hereditary. The New England shops instituted the practice of making "rights" and "lefts," first for men's footwear, then for women's, and finally for all types. The next improvement was to use tin patterns around which the parts were cut from leather thus giving greater precision and incidentally saving much leather. Out of this improvement came the standardization of sizes and uniformity in fulness at the instep. For example, men's shoes were made to vary one-twelfth of an inch in width for each size and one-third of an inch in length. Size 5, measuring 10 inches in length, was taken as the standard from which to gauge all other sizes. Finally the Yankee shops specialized on cheap shoes, selling around $1 a pair, a price that suited the needs of the largest number of domestic consumers. For all these reasons the Massachusetts shops gained notable lead over all competitors.

Small-Scale Industry

The outstanding feature of the shoe industry, then, was its remarkable concentration near Boston although it was represented in every section of the country by small local shops or by wandering artisans. A second prominent characteristic was the long continuance of skilled hand labor which had as corollaries small-scale operation and labor dominance.

Notwithstanding that machines were beginning to enter the cotton industry in 1750, when Dagys, the shoemaker, settled in Lynn, it was not until a full hundred years later that mechanisms began to appear in shoe shops. Shoemaking is essentially a series of sewing operations. Since no machine for sewing with any material at all appeared until Elias Howe's invention in 1850, and since even then it took years to find a machine needle that would sew through leather, it happened that until 1850, shoe manufacture was strictly a hand labor business. Because it was unaffected by machinery for so long a period, shoemaking became fixed as a small-scale industry. Power was not required, for, as we have said, all work was done by hand and the small amount of capital needed was supplied by merchants or "factors."

Shoe Factors

The factors bought leather and had it cut out in their own shops. They then sent the light parts for uppers, which must be sewed together, to the homes of the women or men who did the work. When the uppers were completed they were returned to the factors where skilled men attached them to the soles. Regular "carriers" or "expressmen" were the mediums connecting factors and laborers. They transported, by horseback or wagon, the cut parts to the women; and then collected finished work and conveyed it to the factors from whom they received the workers' payments. Out of these wages they deducted a small commission and handed over the remainder to the workers, upon the next round of journeys. Workers who lived within walking distance of a factor's place of business saved this middleman's commission by going themselves to collect and deliver materials.

The factors were not necessarily rich men; there were scores of them in Lynn and along the south shore who employed only two or three artisans and were themselves cobblers and did all their work in tiny buildings ten feet by fourteen erected in their own back yards. Since there was no machinery involved and the shops were nothing but small sheds, the only capital necessary was the little required to purchase material, pay wages, and hold the finished shoes until sold. Raw material, however, could be bought, a side of leather at a time, and wages could be furnished one week from the shoes made and sold the week before; consequently very little money was needed by a man to embark on a career as a shoe manufacturer. Many manufacturers, too, paid in "orders" on some local store and then made an annual or two-yearly settlement with the store. This system, of course, had inherent in it the possibility of exploitation of labor and it was generally condemned by the time of the Civil War.

An Astounding Paradox

About 1850 machinery entered upon this situation but, notwithstanding that it has almost completely eliminated the hand labor feature of the industry, it has had little effect upon the scale upon which operations are conducted. Between 1850 and 1900 the shoe industry was transformed from one in which the only aids were a lap-stone, a hammer, and an awl, to one in which 300 machines were necessary to make all the different styles of footwear in use, and at least 28 machines and sometimes twice that number were required to produce one shoe. Yet today shoe manufacture presents the astounding paradox of being one of the most thoroughly mechanical industries and at the same time one that exacts the least capital to enter; machinery has brought about such a high degree of specialization that even the burden of capital investment is borne by one company. These unusual features will bear a closer scrutiny.

Introduction of Machinery

The first machine adopted by the shoemakers was one which rolled sole-leather and took the place of hammering the sole to make it hard, compact, and durable—a job that required about an hour and a half by the old method but which the machine performed in one minute. This machine was introduced in 1845 and no further improvements were made until 1851 when Elias Howe's sewing machine was adapted so that it could be used for work on uppers, which for the first time brought this process under the same roof as the other manufacturing transactions and took the women employees away from their homes. At first the machines were so heavy that women were temporarily thrown out of the business, but with improvements in the machine they soon flocked back. Not only was it easier to use Howe's invention first for the uppers but it was also more economical because previous to its introduction the sewing of the uppers was the most costly part of the manufacture. One woman could bind only four pairs per day and the cost ranged from 17 to 25 cents per pair. The machine did the job much cheaper and with greater precision. With this beginning other inventions rapidly followed, especially under the stimulus of the Civil War, but the most fundamental were those associated with the names of McKay and Goodyear.

Gordon McKay, a Pittsfield, Massachusetts, capitalist and manufacturer, took up an invention made by Lyman R. Blake for sewing a sole to an upper by machinery. The first firm to use the new device was William Porter and Sons, of Lynn, who set up the machine in their shop in 1861, an example which was soon followed by all other manufacturers catering to a cheap trade, for the machine produced 300 pairs per day when the utmost a man could make was 10 pairs. The fault of the shoe made by the McKay machines was that the stitching was carried through the inner sole and left a ridge which rasped the foot of the wearer, consequently the invention did not revolutionize the whole industry but only that portion which produced low-priced goods, for high-grade shoes were still hand-made by the welt process.

Goodyear's Invention

A welt is a narrow strip of leather to which the inner sole is first sewed and then afterwards the outer sole is attached. By using this device a sole can be joined to an upper so that no sewing shows on the inside of the shoe, and, a much more important consideration, so that the heads of the stitches do not chafe the foot as is too often the case where the McKay process is used. The welt process, from ancient times, was a difficult method by which to manufacture shoes and necessitated long training on the part of the men who performed the job. The peculiarity of sewing outside the edge of the shoe made it especially difficult to apply any mechanical aid and it was not until 1862 that the secret of using a curved needle to do the work on welts was discovered.

The origin of this ingenious idea by which machinery was practically applied to welt shoemaking is usually accredited to Auguste Destouy, a New York mechanic. His idea was taken up and developed by a man named Daniel Mills and finally brought to perfection by Charles Goodyear, who obtained patents for his welt machine in 1871 and 1875. Goodyear's machine turned out welt shoes which were more comfortable, more exact in workmanship, and cheaper than those formerly made by hand and produced them in twenty-five times the quantity, so that Goodyear may be credited with laying the foundation of the modern American high-grade shoe manufacturing industry. With a Goodyear machine in the factories, the cost of welting, which by the hand method had ranged from 60 to 75 cents a pair was reduced to 10 cents per pair and later to 8. The number and output of Goodyear machines experienced the following growth in the years from 1880 to 1895 inclusive.

GOODYEAR OUTPUT

Year	No. of Machines	Pairs
1880	250	2,000,000
1885	500	4,000,000
1890	1,500	12,000,000
1895	2,500	25,000,000

Displacement of Handwork

The instalment of McKay and Goodyear welt machines formed the basis for a large number of other connecting mechanical devices. Between 1850 and 1900, no less than 4,000 patents were issued to the new industry, so that one worker today can supply 1,000 men with all the footwear required in a year. These various inventions reduced the labor cost of a hundred pairs of shoes from $408, which it had been under the handwork system, to about $35. The last hand process to remain in the factory was the cutting of the parts of leather that formed the upper part of a shoe. It was not till fifty years of experience with shoe machinery and by the expenditure of about a million dollars that a machine was finally invented that could do this work. The consequence of all these improvements is that today a shoe may be completely manufactured by means of machines. It does not often happen, however, that any one factory possesses the complete line of machines, but on the contrary, usually some processes are relegated to handwork; nevertheless, the possibility remains of making a complete shoe by means of machinery.

Cheap Shoes

The sudden revolution in shoe manufacturing methods is one of the most startling features in regard to the industry. At the time of the Civil War shoemaking was one of the industries which had yielded least toward a factory régime, so that when the War opened the shoe business numbered the largest group of employees engaged in any type of manufacturing in this country. Today the shoe industry is just as markedly an example of complete mechanicalization with the result that in America shoes alone, of all the important articles of wear, have no foreign competitor because shoes are better and more cheaply made in the United States than anywhere else in the world. Machines have given to our millions as good a shoe as is worn by our millionaires; the many now have what once the monied alone could enjoy. To have undergone so thorough a revolution in so short a period of years is one of the most impressive features in the history of the shoe manufacturing industry.

Machine Leasing System

Despite the thorough mechanical equipment of a shoe factory, several results that might not be expected have been achieved. Usually the degree to which machinery is used is the mark of the capitalization and consequent large-scale operation of an industry. Shoe manufacture, although it is one of the most mechanical, has yet retained its characteristic small-scale production. The principal cause for this modern condition was the manner in which machinery was introduced into the business. When McKay took his sewing machine around to the masters of the little ten by fourteen shops employing five or six men, the cost of the machine thoroughly frightened away purchasers. McKay found that he could not sell his device. In order that his efforts might not be a failure, he put his machine into a small shop upon a royalty basis, that is, he retained the ownership of the machine while the user of it, the small-scale employer, paid a tax to McKay for every operation on that machine in the making of shoes. Later, when Goodyear came into the market with his contrivances, he found the leasing system so thoroughly entrenched that he too was forced to adopt it.

United Shoe Machinery Company

As the manufacture of shoe machinery expanded it was virtually monopolized by three companies specializing in its fabrication; one, the McKay Shoe Machinery Company, engaged in making sewing machines; the second, the Consolidated and McKay Lasting Machine Company, which made supplies and equipment for the first group; and the third, the Goodyear Sewing Machine Company. Although these companies were seeking dissimilar markets in that their machines were adapted to unlike grades of shoes, nevertheless the savings that could be effected by combination through the elimination of triple sales forces, repair gangs, and general administrative officers were so great that the three groups came together in 1899 and formed the United Shoe Machinery Company. This company now controls more than 95 per cent of the manufacture of shoe machines. Because in each of the basic companies the leasing system had become thoroughly intrenched it was maintained by the United Shoe Machinery Company. Despite serious pressure from the largest shoe manufacturers to introduce a sliding scale of royalties in accordance with the greater or less use of the machines, the United Shoe Machinery Company has never swerved from standard uniform prices. Consequently, the relative machine cost per pair is the same for a shoe manufacturer whose production is 300 pairs as for one whose output is 3,000 pairs.

Small-Scale Operation

The consequence of this policy has been the encouragement of a large number of small-scale shoe manufacturing enterprises. In the principal shoemaking centers such as Lynn, or Haverhill, the local chambers of commerce have erected large loft factories where any desired amount of space may be rented. Inasmuch as the rental includes also power, heat, and light, the only requirements for entrance upon shoe manufacture are either experience in directing the work inside a factory or skill in selling. The most frequent sort of enterprise is a partnership between a man formerly a salesman and another formerly superintendent or foreman who set up business for themselves. Because no capital need be sunk in machinery nor in any building, nor in power, heat, or light devices, all of an entrepreneur's capital may be used for operating expenses, and the business may be started upon a very small scale. The result is that in all branches of shoe manufacture, with the possible exception of men's shoes where the tendency although present is not so marked, the rule is that the greatest number of factories are operated upon meager financial resources.

Factory Specialization

One effect of the universal small-scale operation is a high degree of specialization, for most men, upon entrance into the industry, make no attempt to manufacture all of the parts of a shoe. Since the shoe business is highly localized, it is possible for these beginners to manufacture heels alone, counters, toe-caps, "cut-out soles" or findings. Shoe manufacture, then, partakes of many of the characteristics of an assembly business, some shops making parts only, others combining various pieces, while a few plants gather all the portions and complete the shoe.

The specialization had begun with the making of heels about 1855. The height of heels had been a mark of fashion long years before. Venetian women walked almost on stilts and it is said that Madame Pompadour started the fashion for high heels because she was short. In America, before 1830, high heels were the vogue, then in 1835 spring heels were adopted. After 1840 no heels were worn until 1855. When high heels were reintroduced, journeymen were brought into the factories to make the heels and this job became a specialty. To insure accuracy and to facilitate the job, it was divided into operations of nailing, shaving, blacking, and polishing.

Specialization is also noticeable in the classes of shoes made; no manufacturer makes more than one general type of shoe in any one factory. For example, a factory may specialize on infants', women's, or men's shoes but no one factory makes under its own roof all three varieties. Wherever a corporation sells a complete line it either operates particular shops for each class of shoes or manufactures a part of the line in individual factories and buys the rest from other concerns that specialize in their production. Even regions have become specialized; the neighborhood of Lynn is dominantly engaged in making women's shoes, whereas the vicinity of Brockton confines its activities to turning out men's shoes. Haverhill has become famous for its slippers and soft-sole shoes; Rochester, New York, is best known for its infants' shoes and Philadelphia for high-priced shoes for women.

Commanding Position of Labor

Not only has the leasing system retained small-scale operation and resulted in a high degree of specialization, but it has indirectly furthered the power of labor organizations. Since the employers in the shoe industry as a class are not fortified by masses of capital but are really little removed from craftsmen themselves, and since also the fierce competition of universal small-scale operation prevents any high degree of co-operation between employers, and because the industry is so thoroughly localized that most of the workers in it live within one small area, all the conditions for evolving a powerful labor organization have been set up. The localization has brought the laborers so much into contact with each other that unions were easy to form. The weakness of employers as a class has enabled unions to gain most of their demands. This success in turn has encouraged new members to join the unions and instigated the formation of still other unions connected with the craft. The shoe business has become so highly organized upon its labor side, and the unions have been able to dictate terms so completely that some employers, especially those who have large factories, have found their situation most irksome.

Of late years, therefore, there has been a distinct movement of corporations away from organized shoe-making centers into towns where the manufacture is unknown. This movement away from the original centers is illustrated by the following figures for Lynn. In the face of increased values of shoes the steady figure in the third column indicates decreased output.

Lynn Shoe Manufacture

Year	No. Mills	Value Output
1911	200	$33,000,000
1915	88	33,000,000
1916	80	33,000,000

Movement to New Centers

The town selected for the new location has generally been one that has already established a labor force by means of textile-mills. Since the wages in a shoe factory are higher and the conditions of employment more pleasing than in a textile factory, where the two employments compete for a labor force the shoe factory is generally able to choose the best as the following figures show:

50% male shoe workers earn $15 to $25 a week.
61 " cotton " " 8 " 15 " "
64 female shoe workers earn $8 to $15 a week.
56 " cotton " " 8 " 15 " "
23 female shoe workers earn less than $8 a week.
43 " cotton " " " " 8 " "

The movement of certain Lynn and Brockton manufacturers into cities like Lowell, Massachusetts, or Manchester, New Hampshire, is explainable on grounds such as the foregoing. Of course, the surcease from labor difficulties gained by change of residence is short lived, because the labor union follows the industry, and as the industry becomes nationalized, so also does the labor union.

Branch Factories

Another factor which has brought about a wider distribution of shoe manufacturing is the matter of freight rates. Many of the competing eastern manufacturers selling through large wholesale houses in the West and South have found it an advantage to establish branch factories at those wholesale centers, thus underselling their competitors by the amount of the freight rate between the wholesale city and the parent eastern factory. Once started in any city, the shoe business tends to increase at that point because of the advantage of trained labor. In this way St. Louis has rapidly forged to the front as a shoemaking center. By 1910 it was the third most important shoemaking city in the United States, having displaced Haverhill from that position. By 1914, however, Haverhill had regained its former rank so that today St. Louis is the fourth producing center. Other places have had a history similar to St. Louis, but none of them have reached the degree of success attained by that city. Among these others might be mentioned Cincinnati, Ohio, Rochester, New York, Philadelphia, Pennsylvania, and Petersburg, Virginia. The various important shoe manufacturing centers ranked as follows in the years 1909 and 1914 in point of the value of their products:

Value of Products of Shoe Manufacturing Centers
Per Cent of United States Total

City	1909	1914
Brockton	7.7%	7.5%
Lynn	9.1	7.4
Haverhill	5.7	6.0
St. Louis	6.6	5.3
Boston	5.1	4.6
New York	3.6	4.4
Manchester, N. H.	3.4	3.2
Cincinnati	2.9	2.6
Rochester	2.6	2.3
Philadelphia	1.3	1.5

Effect of Leather Substitutes

Having shown that the shoe industry has changed from a local to a localized one and from a handwork to a machine basis, it remains to point out that it is now facing a revolution in raw materal. Since this was discussed in Chapter VIII on tanning it needs no fuller illustration here; it might be interesting, however, to raise the question as to what effect a change in raw material may have upon the present organization of the shoe business. Hitherto no change is noticeable. The introduction of fiber soles instead of leather has produced no appreciable results, because these soles are attached to shoes in exactly the same way that leather is. The present raw materials are collected from widely separated points whereas the new manufactured ones are produced in the shoe district. Hence the established centers gain prestige by the shift in material.

Nevertheless, with the invention of an artificial leather for use as uppers and perhaps some other changes or improvements in artificial sole-leather, there is a possibility that shoes may be manufactured by a new method. If materials other than leather were utilized for manufacture, it might be possible to mould the shoe into form in some such way perhaps as rubber shoes are now manufactured. If this were done, the whole shoe manufacturing business would have to be reorganized because the premium now put upon skill in operating machines would be largely eliminated and deft semiskilled girls, after a short intensive training, might be fitted to do the work. Furthermore, unless the United Shoe Machinery Company foresaw the tendency and met it by patenting machines for moulding, their basis for monopoly would be swept away. It is not at all improbable that some such reorganization may occur.

Rubber Shoe Industry

Early Rubber Imports

A discussion of shoe manufacture would not be adequate or complete without some small explanation of the relation between rubber shoe manufacture and leather shoemaking. The rubber shoe industry, although not so ancient as the leather, has nevertheless had an honorable history in this country. It began in the earliest days of this Republic when our swift sailing vessels, touching at the obscure ports of the world, brought to our shores the strange products of out-of-the-way places. Among other things which were brought into the New England harbors at Salem, Providence, and New Haven was pure rubber from the Para district of the Amazon. The exact date is uncertain. Rubber was first carried to Salem by Captain Benjamin Upton in 1824, but Boston is said to have received rubber shoes in 1820, and Thomas Wales to have imported them into Boston in 1825.[2]

Although at first rubber was a curiosity rather than a commodity, returning captains told tales of its being used for footwear in the places where it was produced.

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[2] Dair's, W. T., New England States, Volume I, page 336.

Yankee ingenuity soon took advantage of this hint and sent footwear forms to the Amazon over which rubber was moulded and sent back to this country. Pure Para overshoes at that time were not unknown, a thing which seems an amazing luxury at the present time. Between 1835 and 1856 the imports of three cities were:

IMPORTS RUBBER SHOES—1835-1856

City	Pairs
Salem	1,792,098
New York	1,518,532
Boston	575,904

Vulcanization

Rubber, however, could not enter into industry in any large degree because it was soon discovered that it was greatly affected by changes in climate. Cold weather made it brittle, warm weather made it sticky, fats, oils, and perspiration rotted it, so for most uses its faults prohibited its adoption. It was not until after long years of experiment and heartrending failure and almost despair that Nathaniel Hayward and Charles Goodyear finally, by accident, learned the secret of vulcanization. They found that varying admixtures of rubber and sulphur heated to varying temperatures gave products that ranged all the way from those that were extremely elastic, or soft, to those utterly immobile, or hard. Industry, therefore, seized upon this new material and it is now used for a great variety of articles.

Localization of Industry

The rubber shoe industry in which we are especially interested grew up around the ports that first imported the raw material so that a number of rubber factories were established in and near New Haven—at Naugatuck and Beacon Falls, Connecticut—surrounding Providence, or girdling Salem, all of which date their origin from the time when rubber was first introduced. As the years have passed, however, there has been a constant tendency for rubber shoe manufacture to creep near Boston in the neighborhood of leather shoe manufacture. This movement is not due to any likeness in the process of manufacture, or in any of the raw materials employed, or in the sort of labor which is utilized, for in all these matters rubber shoe manufacture differs from leather. The process of manufacture is one of cutting small parts, cementing them together, and baking them into one homogeneous article. The raw materials consist of cloth, crude rubber, sulphur, and various other commodities. The labor except for that on heavy rubber boots, or heavy artics, or overshoes, which jobs are performed by men, is largely suited to the work of women so that all rubber factories employ a larger proportion of women than they do men. The jobs are so minutely subdivided that any girl of ordinary intelligence in a short period can learn to do the work.

Same Marketing Channels

If, then, it is not similarity of process, material, or labor that causes the bringing together of rubber and leather shoe manufacturing plants, we must look elsewhere for the explanation. The fundamental reason is that both rubber overshoes and leather shoes are marketed through the same channels. The same wholesalers handle both types of shoes and retailers display them side by side on their shelves. The writer has known a retailer whose store was four miles from the Beacon Falls Rubber Shoe Company, of Beacon Falls, Connecticut, who received orders from the factory that were shipped from the Boston distributor. The advantage of reaching a market that has already been created by the leather shoe business is the cause for the localization of the rubber shoe manufacture in the same region as the leather. Since the feminine members of a leather shoe-worker's family may find employment in the same shops with the male members, rubber shoe plants do not locate in the same town where leather shoes are made but at some other place near at hand where there are jobs available for men alone. The two footwear industries are prominent in the same region but not in the identical cities. The concentration of rubber shoe factories near Boston, already well defined, is becoming more so each year; in 1909 Massachusetts had 37 per cent of the rubber shoe business, in 1914, 44 per cent.

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CHAPTER X

THE PAPER INDUSTRY

Early Paper-Making

Raw materials and labor were the first great influences in American paper manufacture; later, machinery played the leading rôle; and more recently changes in raw materials have had a most marked effect on the methods and place of manufacture as well as on the general organization of the industry.

Colonial Americans did not inherit their paper industry as they did most others, from their mother country, Great Britain; indeed England preceded America by only a few years in the establishment of her first paper-mill. In Europe, during the infancy of the industry, the determining factors were raw materials and labor neither of which requisites of the proper sort England possessed. Paper was then made from linen rags; since the British people were clothed in wool or leather, they could not hope to manufacture paper because leather was obviously unfit for the purpose; wool, an animal fiber, was equally useless on account of its tendency to dissolve when beaten into pulp. What linen England used was imported from Germany, Flanders, or Holland, so naturally enough these were the places from which England also obtained her paper. Inasmuch as the English were unversed in the art of paper-making, the industry was unknown in the English colonies of America although linen cloth was commonly woven and worn. But where the Germans and Dutch were settled, there you might expect paper-mills to arise.

Pennsylvania Mills

The German and Dutch immigrants were principally religious refugees whose tenets were similar to those held by the Quakers consequently William Penn's colony became a sanctuary for the whole eccentric group. Among the many sects that went to Pennsylvania were the Mennonites whose first minister and bishop was a man named Rittenhouse, a native of Broek, in Holland. Paper-making had been a Rittenhouse family trade practiced for several generations in their European home so the Mennonite immigrant was a skilled artisan when he arrived at Philadelphia. In response to the demand of William Bradford, the printer, for paper, Rittenhouse set up a mill in 1690 at Germantown, Pennsylvania (now a part of Philadelphia), on the bank of a little brook that empties into Wissahickon Creek. William DeWees, whose name indicates his Dutch origin and who was related by marriage to Rittenhouse, built a second paper-mill on the Wissahickon in 1710. From these two impulses Philadelphia and its environs became the leading paper-making center of the colonies. Since no other colony possessed the necessary skilled labor to carry on the work, we find contrasts in 1769 showing that when there were 40 mills in Pennsylvania, New Jersey, and Delaware, New England had but 3; and again 18 years later, in 1787, of a total number of 63 mills in the United States, Pennsylvania claimed 48.

Raw Material Supply

Philadelphia not only had the labor for the manufacture of paper but also the raw material, namely, linen rags. The city was one of the largest in all the colonies and for that reason alone yielded a large quantity of rags; moreover its position as one of the leading ports enabled it to import rags easily; and finally, the spinning, weaving, and knitting of linen had become a recognized, localized industry at Germantown. Another factor that was not without its bearing was the greater amount of linen clothing worn in Pennsylvania than in the colder New England colonies where wool was a requisite for warmth. Paper cannot be made from wool rags because, being of animal origin, they disintegrate when in contact with the chemicals used in paper manufacture. Linen rags were more easily obtainable in large amounts at Philadelphia then than any other place in the colonies.

In addition, Philadelphia offered an excellent market for paper. It was the social and political capital of the colonies and as such it encouraged the growth of mills. Not only William Bradford but Franklin too had his press in the City of Brotherly Love; and Franklin alone was influential in establishing 18 paper-mills near the city.

Scarcity of Linen Rags

Outside of Philadelphia the paper industry was almost unknown. The original difficulty in respect to skilled labor was surmountable because the mills around Philadelphia acted as a training school, and paper-makers were notoriously prone to wander; but the scarcity of rags could not be overcome. Advertisements imploring housekeepers to save their cloth scraps yielded scant results. Prizes were offered by associations, such as that of the American Philosophical Society, granting a reward of $25 to the family that saved the most rags and another $25 to the individual whose record was highest, but not even these, in addition to the price received for the rags themselves, succeeded in bringing out any great hidden resources. Even legislation compelling people to save rags met with little response for the colonists did not have rags to throw away, give, or sell. Consequently the paper industry, vitally dependent upon raw materials, limped feebly and was everywhere conducted upon a small scale. It was operated sporadically, and was limited to the region of the mill.

The Revolution heightened the scarcity of rags by decreasing the supply at the very time when paper was in greatest demand. The war shut off imported raw material and the enemy held the big towns of Boston, New York, and Philadelphia; yet the colonial army officers needed paper for their orders and the public was extraordinarily interested in pamphlets and newsletters. People were forced to curious makeshifts to enable the scant supply of paper to fulfil the needs. The margins were made to carry three and four lines of printing, and old sermons or pamphlets that had utilized only one side of a sheet were collected and printed on the back. Paper torn in transit from the mills was carefully and skilfully patched; in short, every scrap of paper was made to do full duty. To encourage paper manufacture the employees were exempt from military service and even prisoners of war, particularly Hessians versed in the art, were sent to the mills to make paper. But rags were the limiting factor; paper could not be produced without them and the supply was exceedingly restricted.

Cotton Paper

In the years following the close of the war the situation of paper-mills in respect to raw materials became slightly easier, because a new source appeared. Linen commenced to have a competitor in cotton and rag collectors began to learn that textile-mills were as fruitful as the homes in yielding scraps. This new material tended to shift the industry away from the Philadelphia district where it had held sway for over a century to Massachusetts where most of the new cotton factories were built. Between 1794 and 1796 20 mills were started in the state whereas before the Revolution there had been but 3. But since the difficulties of transporting rags prevented the marked concentration of paper-making at any one place, the industry remained local, dependent upon the regional supply of raw material.

Fourdrinier Machine

Meanwhile a new element influencing the destinies of the industry appeared; machines for the first time started to supplant hand labor in the production of paper. From 1690 down to 1825 paper was manufactured almost entirely by hand. The only important mechanism that had entered the business was a machine, introduced about 1750, for washing the rag scraps, tearing apart the fibers and reducing them to a pulp. This machine was known to the trade as a "hollander," a name not without significance.

The most momentous event in the paper industry was the invention of the Fourdrinier machine. This ingenious piece of mechanism was conceived in 1799 by a French paper-worker named Nicholas Louis Robert, through whom it came to the attention of St. Leger Didot, the publisher; he in turn transmitted it to his brother-in-law John Gamble who carried it across the channel to Henry and Sealey Fourdrinier, wealthy wholesale stationers in England. Although they spent over

$300,000 in perfecting the idea, and brought it to such a complete success that it has never been radically improved, yet as with so many inventors, financial ruin was their only reward. Their name attached to the most fundamental machine now in the industry is a sort of spiritual recompense.

This machine which is capable of performing all the work of forming and finishing paper from the pulp, was ready for use in 1818 but we did not adopt it in America until after 1825. Two American paper manufacturers—Gilpin of Wilmington, Delaware, and Ames of Springfield, Massachusetts—who had been working upon the same problem, brought forth machines in 1816 and 1822 respectively. These paved the way for the Fourdrinier, but coming first, checked the introduction of the English invention.

Dependence on Transportation

By far the most important reason, however, why machines in general were so slowly adopted by paper-makers was the lack of transportation. The machines necessitated more raw material than any locality could produce, consequently until communication was so improved that one town could call upon the nation for rag supplies, and conversely the nation could fulfil its wants for paper from the product of a few well-located mills, the advance of paper-making mechanisms was curbed. In 1829 of the 60 mills in Massachusetts only 6 had machines. But the rapid growth of railway mileage between 1830 and 1850 relieved paper-mills from local dependence and was immediately effective in encouraging the use of machines in the mills. This may be shown by the patents issued:

Before 1800	only 4
1800-1839	88, or 2+ a year
1839-1884	1,063, or 24 a year

Once machinery was released from the restrictions on the raw material or market, it became the dominant feature of the industry.

Leadership of Berkshire Valley

Its first marked effect was to intensify a movement for localization already commenced. As we have shown, the use of cotton rags tended to pull the industry away from Philadelphia where it originated to Massachusetts where cotton-mill clippings were most abundant. Within Massachusetts, after 1801, the industry commenced to concentrate around three points: the first, about Boston; the second, near Worcester; and the third, the Connecticut and Berkshire valleys in the western part of the state. The Boston region was supplied with raw materials not only from the city itself and from import and sail-loft wastes, but also from the cotton-mills to the south near Providence and to the north at Lowell, especially the latter. Worcester drew upon the many textile plants of the Blackstone Valley, while western Massachusetts depended on mills about Springfield, or North Adams. Gradually the Berkshire Valley assumed a noticeable leadership in the manufacture of fine papers for which the purity of the water and air gave the region an advantage. Lee, in the heart of the Berkshires, became the most important paper-producing town in the United States. At this point, however, machinery entered the business and changed its destinies.

High Power Necessary

The Fourdrinier is a large, heavy, fast-running machine ranging from 5 to 18 feet in width and from 25 to several hundred feet in length and operating at a speed varying from 100 feet per minute up to 650. Such a massive mechanism requires a large amount of power to operate. Moreover, since it is concerned with the middle and concluding processes in the manufacturing procedure, to keep it in motion a great supply of pulp must be prepared in the primary processes. This means that the washers and beaters must be large or numerous; in either case the power demands are much enhanced and the amount of water used in the mills is correspondingly increased. It is obvious that the small streams that sufficed for the little mills, machineless except for their two or three hollanders, would soon become utterly inadequate under the new machine régime. In short the use of the Fourdriniers impelled a search for power sites upon large rivers.

Above Holyoke the Connecticut River, New England's mightiest stream, falls 70 feet within 2 miles. When a dam was built across the river at Holyoke, this fall, together with the great volume of the river, gave the largest power project in New England. No better place could then be chosen for a paper-mill, and the response was immediate. The Parsons Paper Company, in 1853, was the first to take advantage of the Holyoke opportunities and the example was soon followed. Within a quarter of a century the city became the largest producer of fine writing-paper in this country and in the world.

Machinery was so important in this development that it revolutionized the industry. In addition to concentrating the business at Holyoke, it completely changed its capitalistic aspects. Before 1828 anyone with $3,000 to $8,000 could enter the business, but since that time it has required anywhere from $20,000 to $500,000. The combination of localization and capitalistic enterprise led to the early combination of mills. The American Writing

Paper Company is now in virtual control of its brand of the paper business. In 1916 it owned 22 mills and was capitalized at $25,000,000.

Range of Raw Materials

Long before the formation of the American Writing Paper Company rag paper had ceased to be the prevailing variety manufactured. The age-long struggle to secure sufficient rags to keep the mills running reached the climax about 10 years before the Civil War, at about the same time Fourdriniers came into general use. The demand for paper was incessantly greater, Fourdrinier machines made large output possible, but the supply of rag raw material was so limited that it held the paper industry in leash. The only way out of the difficulty was to find a substitute for rags.

It is possible to manufacture paper from any fibrous material; in truth no less than 500 different things have at some time or place been so employed. But the range of commercially practicable raw materials is limited by several economic considerations. First, the substance must not contain chemical compounds that make pulping, bleaching, dyeing, and sizing difficult; second, the paper resulting from the raw material must be reasonably durable; third, there must be no competing use for the filter—for example, cotton fiber although an excellent raw material for paper, is too valuable as cloth to permit its use directly in paper manufacture; fourth, the fiber must not be difficult to extract; fifth, there must be a large supply near a market; and sixth, the material must be cheap.

These essential factors confine the practicable raw materials to a narrow field. Those that have been substituted for rags are old rope used for jeweler's tissue, straw made into wrapping paper or cardboard, and old and waste paper remanufactured into low-grade "scratch pads." Between 1850 and 1860 almost all news-print paper was manufactured from straw, the *Public Ledger* of Philadelphia being one of the first publishing houses to use this variety of stock; but the greatest substitute of all is wood, now the principal ingredient of all papers of temporary value.

Wood-Pulp

Spruce, hemlock, and poplar sticks can be ground on a stone, reduced to a pulp, and manufactured into paper, a mechanical process of making wood-pulp that was discovered before 1800 but not developed until after 1840, when the need for a rag substitute became increasingly urgent. The idea is said to have originated from observations on the building of wasps' nests. Paper made from mechanical pulp is very weak because its component fibers are so short, a fact that led to the perfecting of chemical processes for the procurement of wood-pulp. By these processes the wood is first chipped, then put into a tank containing either acid or alkali which eats out the organic matter in the wood and leaves behind the fibrous cell walls. After the excess acid or alkali has been removed the fibers are pulped and made into paper.

Mechanical pulp is easy to make and cheap but lacks strength, whereas the chemical pulp, although harder to manufacture and therefore more expensive, results in much stronger paper since strength is determined by length of fiber. Consequently, for most paper a mixture of the two varieties of pulp is used; for newspapers, as an example, the composition is 70 per cent mechanical and 30 per cent chemical.

Cheap Power Essential

The use of wood-pulp has as completely overturned the paper industry as the introduction of Fourdrinier machines. Since it requires from 66 2/3 to 100 horsepower to grind one ton of wood mechanically, and since we consume more than a million tons of wood annually for the manufacture of this variety of paper, it is apparent that cheap power is a very essential element. The cheapest power available is that derived from water; consequently the modern paper business, even more than the old, must seek the largest available water sites. Most of the old-established centers could not make wood-pulp paper because the mills were located at power sites conveniently close to cotton factories whereas the new mills must seek the forests. These facts explain why Massachusetts was able to lead in paper manufacture from 1830 to 1890, but that since that time the state at the head of the paper industry has been New York. Second place has been held by Massachusetts. Besides New York, the competition with Maine, Wisconsin, and Michigan is also becoming acute, because these states possess both the water power and the forests necessary to maintain a paper-mill.

In the year 1914, according to their percentage of the total value of paper made in the United States, the states ranked thus: New York 17 per cent, Massachusetts 13 per cent, Maine 12 per cent, Wisconsin 9 per cent, Pennsylvania 7 per cent, Ohio 7 per cent, Michigan 6 per cent, and New Hampshire 5 per cent. Massachusetts still leads in the manufacture of rag papers and also stands first in chemical wood-pulp. The latter is more closely related to her own industry than mechanical pulp and moreover does not require such excessive amounts of power.

In the past, paper-mills were city projects; today they tend to become backwoods enterprises. In the future the big publishing houses may move to the forest's edge so as to be near their supply of paper. While the editorial offices will be kept in the cities, the actual presses may be many miles away where forest and country town merge.

Supply of Wood

The change of raw material from rags to wood produced one other significant feature of the paper business. When rags were employed, paper-makers had little interest in the production of their own raw material; they could hardly make their own rags and it would be ridiculous to invest in a cotton-mill just to obtain the rags it turned out. Moreover the supply of rags did not depend upon the demand for paper but upon the sale of cloth; hence the factor most influencing the production of raw materials for the paper industry was not within the industry itself but entirely divorced from it. When the paper manufacturer forsook rags and took to wood, he was suddenly confronted with the necessity for controlling his own sources of supply. There was no intermediary between him and a spruce tree. If he wanted it he had to cut it, and if he wanted another he had to plant it. Since unfortunately a crop of trees, unlike a crop of cotton or flax, is not a matter of one year's time but forty, to insure a supply of raw materials, paper-makers had to become heavy investors in forest land. Unlike lumbermen, the paper-makers were forced to cultivate their holdings because their mills were too expensive to move. Small portable sawmills may follow the retreat of timber from a given district but a modern paper-mill involves so much large, powerful, expensive machinery, and is so limited to large water power sites that it is necessarily a permanent structure.

Forest Reserve Holdings

Since, then, a paper-mill cannot accompany a waning supply of wood, the forest near the mill must be preserved. To run one fair-sized mill on a 40-year rotation requires from 25,000 to 100,000 acres of forest land. This makes paper manufacture an extremely capitalistic venture, because water power sites must be purchased and developed, large mills full of expensive machinery must be procured, and then to cap it all large reserve holdings of forest-land must be bought. An instance may be cited in the Great Northern Paper Company, a corporation organized in 1899, with a capital of $4,000,000. It built one of the largest mills in the world at Millinocket, Maine, and later put up 5 other plants. To guarantee its raw material it invested in 260,000 acres of timber-land. That these figures are not unusual is shown by the fact that in 1912 the 19 new paper and pulp enterprises inaugurated that year had a capitalization of over $15,000,000, and that in the census period of 1909 no less than 95 per cent of the total value of the national output came from mills whose yearly product was worth upwards of half a million dollars.

A Large-Scale Enterprise

The great amount of capital required to equip completely a modern paper plant effectually limits the number. When any man with $3,000 could enter the business the number of mills was much greater than now when $3,000,000 is not an exorbitant capitalization. The greatest number of mills were in operation in 1899. Since then there has been a constant decline in the number of mills but at the same time a rapid increase in the amount of capital invested in the business. The number of mills in 1909 was nearly 10 per cent less than in the previous decade but the capitalization had advanced 135 per cent.

The next step, which is very naturally and easily taken when an industry is confined to a few large-scale enterprises, is to unite the parts into a compact whole. We have shown that this occurred at Holyoke in the rag-paper industry; it also took place in the wood-pulp group. The International Paper Company was organized in 1898. It acquired the most important mills manufacturing news-print paper in the eastern states and has gradually added other paper- and pulp-mills, woodlands, and water power sites. Its assets are worth considerably more than $50,000,000 and included, in 1916, 31 different establishments.

Most Important Branch

The wood-pulp branch of the paper business is by far its most important member. Of all paper manufactured 61 per cent uses wood as its basic material. All newspapers, most magazines, and many books are printed on this variety of stock. It has the great advantages of being cheap and yet good enough for the temporary uses to which it is put. Its great defect is that paper made from it turns yellow or brown with age, becomes brittle, and crumbles into dust. As a result, where permanent records are necessary, wood-pulp paper cannot be used but a more durable variety must be employed. For quasi-permanent books such as new fiction, whose place in permanent literature is in doubt, paper made of a mixture of rags and wood-pulp is sometimes enlisted into service.

Straw Paper

The middle group of paper products is composed of wrapping paper and cardboard. Rye straw in the eastern states, and oats or wheat straw in the Middle West are, as indicated in the table below, the principal raw materials for this part of the paper industry.

PAPER RAW MATERIALS—1909

Wood-pulp	61.6%
Old waste paper	21.4
Rags	7.8
Straw	6.6
Old rope	2.6
	100.0%

There has been a series of attempts to push this group into the form of organization common for wood-pulp or rag papers, namely, large-scale production by monopolistic combines. None of these attempts have been completely successful, because potential competition thwarts the monopoly privilege of maintaining high prices. Since raw material is abundant and easily increased in amount, and inasmuch as no special skill is required in the manufacture of wrapping paper, mills have been kept to the smaller sizes.

Miscellaneous

The lowest round of the paper industry is found in the mills making tissue-paper, carpet lining, and all special papers. For these industries the raw materials, old rope, waste paper, rags, and straw are obtained near the mill door. In this branch, as a consequence, the primitive conditions of 1825 still prevail. Near Philadelphia upon a tiny brook 3 miles from any railroad there is a small mill containing one paper machine about 30 feet long and employing 3 men. In the summer on clear days these men forsake the mill and go to farming on the mill property. Little mills of this type are scattered all over the eastern United States, and they always produce tissue-papers, carpet linings, or some other special paper.

This, then, is the story of paper manufacture in the United States. It was at first most influenced by skilled labor and later by raw materials (rags). Machinery entered as a revolutionizing agency after 1825 and then came a great shift in raw materials from rags to cheaper, more abundant wood or straw. Each economic factor in its turn has determined the location and organization of the industry.

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CHAPTER XI

MISCELLANEOUS INDUSTRIES

In the preceding chapters we have dealt in detail with a single industry but, because the space limitations of this book and the relative importance of the industries themselves do not warrant extended treatment, this chapter is devoted to a variety of unrelated manufacturing enterprises. We will survey briefly the cement, pottery, brick, and glass industries, wood industries, food products, the building of ships, and making of clothing.

CEMENT

Composition

Cement is a product composed of lime plus clay and sand. The usual raw materials are cement rock, clay, or shale (solidified clay), blast furnace slag, or a special lime-bearing clay known as marl. As a result of the different materials added to lime in various places, cement ranges in color from white through gray to brown. Cement rock is the favorite material in the East, while clay or shale predominate in the plants in other parts of the country. The use of blast-furnace slag has been limited necessarily by its weight, bulk, and low value to the neighborhood of large steel furnaces. Marl is employed where none of the other materials are easily available.

Not only has cement been made from a variety of ingredients, but the product itself has never been one distinct, standard commodity, for three markedly different kinds have been known. Puzzolan cement is one manufactured by a physical combination of the three elements (lime, clay, and sand) of which all cements are made. It differs from the other two varieties in that after blending the materials are not changed chemically by a heating process. Natural cement is made from impure limestone containing varying amounts of clay and sand which, after grinding, is burnt in kilns. Portland cement, a comparatively new product, is made by mixing definite proportions of lime, clay, and sand, burning the mixture in special kilns at a temperature ranging around 3,000 degrees Fahrenheit, a point that is 14 times as great as boiling water. The resultant clinker is ground to a powder and is then ready for use.

Puzzolan Cement

In the historical development of cements, puzzolan came first. The Romans manufactured this variety by uniting powdered volcanic ash physically with lime. With this cement the Romans built some of their most famous highways, aqueducts, and buildings, many portions of which have endured for 2,000 years. The art of making puzzolan cement was lost during the Middle Ages and lime was the only binding material known throughout all those centuries. Curiously enough, the most recent invention in cement has been a revival of a material analogous to Roman puzzolan. Blast-furnace slag, which is the accumulation of impure matters driven off from iron ore by the use of lime flux, is now ground into a fine powder and the proportions of lime, sand, and clay corrected so as to produce a usable cement. For scores of years, the disposal of this slag has been a problem at all steelmills, for it has had no value except as railroad ballast, was hard to handle, and cluttered the premises. Today it may be thrown into cars at the mouth of the furnace, shipped to a nearby subsidiary mill, and there made over into a greatly demanded cement. Aside from the figurative resemblance between a volcano and a blast-furnace, the Roman and American puzzolan cements have other features in common; ash and slag are composed of similar elements, and the cement made from them has always been a physical product rather than a chemical product.

Natural Cement

In modern times the first cement to attain wide popularity was the natural variety whose virtues were discovered in 1756 by an English engineer named Smeaton. In searching for a binder which would harden under water and at the same time resist the corrosive action of water, Smeaton found out that certain impure limestones when added to a small amount of clay gave the desired result. Smeaton put his findings to a successful test when he utilized natural cement in the building of the Eddystone Lighthouse. After 1796, English and French engineers improved upon Smeaton's practices by subjecting Smeaton's materials to a burning process longer and at higher temperature than that customarily used for lime. Since the raw materials they used were found already in rocks, the engineers called the commodity "natural cement." This article became common in the United States after 1819. In building the Erie Canal, investigators were startled to find that the limestones which had the best binding quality were those that were impure rather than pure, thus repeating in the United States the much earlier discoveries which Smeaton had made in England.

Canal Building

The great value of this discovery in constructing Clinton's "Big Ditch" led to its application in all the other waterway projects that immediately followed the successful operation of New York's experiment. There came to be, therefore, a close association between the manufacture of natural cement and the extension of canals. All of the important eastern canals had adjacent to them cement manufacturing plants. The Chesapeake and Ohio Canal was supplied from the mills at Cumberland and Roundtop, Virginia; the Lehigh, by those at Siegfrieds and Coplay, Pennsylvania; the Richmond and Allegheny, by that at Balcony Falls, Virginia; while the Delaware and Hudson drew its supplies from the plants at Rosedale and Kingston, New York; and the Falls of Ohio Canal relied upon Louisville, Kentucky, for theirs.

The canals not only were the cause for the starting of these mills and afforded them their first great market, but after the waterways were finished, the proximity of easy barge transportation to the places where cement was manufactured enabled the mills to continue existence by sending their heavy, bulky, low-valued product by water to the village, town, or city markets. It is interesting to note that this factor influenced the standard package for cement in that the best method for shipping the product on canals was in barrels because they protected the material from water and prevented a cargo from shifting. At the present time, although cement is almost entirely carried in bags by railroads, price quotations and computations of output are always made in terms of the barrel of 380 pounds. The natural cement industry experienced a rapid growth until 1899, due to the simultaneous increase in population in many eastern cities and towns in which natural cement had no effective competitor for construction of stone or brick buildings.

Portland Cement

Portland cement, whose name is derived from its fancied similarity to a once famous English building stone secured from the Isle of Portland, differs from natural cement in the facts that it is burned at a higher temperature and fuses into a clinker. Although made from similar substances natural cement in its manufacture never radically alters the chemical qualities of its materials. The Portland cement clinker is neither physically nor chemically like the lime, clay, and sand of which it is composed but is in reality a distinctly individualistic commodity. It is as different from its raw materials as paper is from rags.

Although Portland cement was patented in England by its inventor, a man named Aspdin, as early as 1824, it had very little influence in the United States until after 1870. About that time it was produced in several places, notably at Coplay and Wampum, Pennsylvania, and Kalamazoo, Michigan. Only a small amount was manufactured in any of these plants, but even this unimportant output found difficulty in gaining a market. One reason for this condition was that the Portland cement was made at natural cement plants as a by-product and its makers so little understood their job that the results were extremely variable and unsatisfactory. The price of Portland cement, also, was higher than natural cement and its superior virtues were so little appreciated and so inclined to be vitiated by the variability of the product that builders, contractors, architects, and engineers could not be induced to depart from their general practice of using natural cement.

New Fuel

Since 1899, however, Portland cement has been manufactured in increasingly large amounts; in fact, the growth of this industry is one of the most startling changes known in modern industry. The complete reversal from the conditions prevailing before 1899 is due to several factors. Since fuel was an outstanding element contributing to heavy charges against manufacturing, attention was turned toward a new fuel or the more efficient use of the old ones. For a while the goal appeared to be reached by the adoption of petroleum, following an example set at Roundout, New York, in 1899. But the price of petroleum soon began to advance in the same way that anthracite had done previously, so both had to be abondoned. The sought-for economy was realized by powdering soft coal and blowing it into kilns by compressed air. Since 1895 hardly any other fuel has been used except natural gas in regions where gas was available. The efficiency of blowing these fuels into the kiln was so much greater than the old-fashioned method of burning with anthracite as to warrant a lowering of the market price of Portland cement.

Rotary Kiln

Another improvement of greater importance was the elimination of the old-fashioned kiln, such as had been employed for ages in the burning of lime, in favor of a newly invented rotary kiln. The latter was at first only 60 feet long and produced but 200 barrels a day, but even that was such an advance over previous practices that again the selling price of cement could be lowered. With constant proficiency in the rotary kiln so that today kilns of 120 or 150 feet in length are common, and with a corresponding advancement of production from 300 to

600 barrels a day per kiln, the downward tendency in the market price of Portland cement has been accelerated. The rotary kiln is peculiarly American because, although it is relatively expensive in fuel it radically conserves labor whereas the stationary kiln, while saving on fuel, adds to the cost of labor. Our richness in coal resources and our poverty in labor contrasted with the opposite conditions elsewhere has led to the more general adoption of the rotary kiln in this country than in any other.

Grinding Apparatus

A third factor in lowering the price of cement has been the invention of improved grinding apparatus. Wherever the raw materials for cement are in the solidified condition—that is, in the form of cement-rock, shale, or limestone—they must be ground before they are burned. The clinker also has to be reduced to a powder by grinding. The clinker has such a peculiarly cutting effect on on the machines used to pulverize it that the repairs and replacements on the grinding apparatus amount to about 10 per cent of the total cost of production. Since the coal fuel also must be powdered before being blown into the kiln, all told, the grinding processes are among the most important in cement manufacture. Improvements or economies effected in the grinding departments therefore have had a direct influence upon lowering the cost of production and consequently have aided in lowering the selling price.

Price Decline

A general review of Portland cement manufacture since 1899 would reveal on the one hand that we have experienced a constantly reduced price per barrel, the commodity having fallen from about $3 in 1880 to 80 cents in 1910; on the other hand, it would show that the principal materials competing with cement have advanced just as consistently in their price. Wood, which was the chief of these competitors has, as everyone knows, had a very rapid rise in price in recent years. For example, at Dartmouth College where this is written, white pine lumber has tripled in price in the last 15 years, an increase that is by no means unique. These facts have had an important bearing in the amazing growth of Portland cement manufacture in the last 20 years.

Standardization

Another factor influencing this change has been the removal of the non-uniformity in the character of Portland cement to which users objected. In order to standardize the product a committee was appointed, selected by the leading engineering societies, chemical experts, and the manufacturers of the cement itself. This committee, after a long intensive study and many tests, finally arrived at definite standards to which all Portland cement has since conformed. The removal of this drawback, together with the lowered price due to better manufacturing methods, has made Portland cement one of our most common building materials.

Location of Plants

A map of the plants manufacturing Portland cement in this country would show a wide dispersal. This is not due, as some writers have inferred, merely to the fact that the raw materials are found nearly everywhere but rather to the importance of market and fuel. Since cement is bulky, heavy, and cheap, it cannot be carried far without doubling its cost, and inasmuch as each increase in selling price renders it less able to compete with wood, brick, or stone, it follows that it must be manufactured near the place where it is used. A casual glance at a map showing the location of the plants creates the impression that cement-mills are everywhere, but a more careful study reveals that all the mills are grouped around some large city. New York City draws upon 5 plants in the Hudson-Champlain Valley and a dozen more in the Lehigh Valley; Philadelphia and Baltimore are supplied from the Lehigh Valley; Pittsburgh gets its cement from 3 plants in western Pennsylvania and 1 in eastern Ohio; Cleveland has 2 near-by mills to supply its needs; Chicago and Detroit are the markets for 11 enterprises in Michigan; Chicago also consumes the product of 7 manufacturers in Indiana and Illinois; Kansas City is the user and distributor of the supplies of 12 mills; Dallas, Denver, Salt Lake City, Los Angeles, San Francisco, and Seattle each support 2 to 4 mills apiece.

Market and Fuel

Inasmuch as a cement plant requires a large amount of capital in proportion to the value of its output, it can only succeed where a large market permits the economy of large-scale production. Furthermore, fuel enters into the exact location of a plant in a marked way. The standard barrel of cement containing 380 pounds requires from 200 to 300 pounds of fuel for its manufacture. Since each kiln burns the equivalent of from 6,000 to 9,000 tons of coal per year, the supply of a good grade of coal or a resource of natural gas or fuel oil within short hauling distance of the plant and selling at a price which does not add prohibitively to the cost of production, is a highly important consideration. As a consequence, cement plants do not tend to seek the best grades of lime, shale, cement-rock, or marl, but are located in respect to the market and fuel supplies, even where low-grade materials are the only ones available. Although each city of considerable size has one or more cement-mills near it, the business cannot be called a local one in the same sense that bakeries or ice cream shops are local industries.

Lehigh Valley

Within the industry, the most marked localization of manufacture occurs in the Lehigh Valley, partly in Pennsylvania and partly in New Jersey. The primary cause for the supremacy of this district lies in its nearness to the large construction markets in New York, Philadelphia, and Baltimore. The valley has excellent railroad connections established for the hauling of coal to these markets, but fully utilized by the cement manufacturers. Furthermore, the district is in the region of cheap fuel, for the price of bituminous coal is kept down by the potential competition of the adjacent anthracite mines. It happens too that this valley contains a large deposit of high-grade cement-rock. This rock has the advantage not only of containing the elements of cement already mixed but also of being easy to quarry and relatively free from water. Limestone is quarried in the same pits with the cement-rock. Since the rock is dry and the materials prepared by nature, the cost for fuel and grinding is reduced. The rapid increase in the use of cement in all other parts of the country, however, has led to the installation of so many plants outside of the Lehigh Valley that the relative importance of the district in the industry is constantly declining, resembling in this respect the position of the city of Pittsburgh in the steel industry.

Analogy to Steel

There are many other similarities also between the making of cement and steel. Both are cheap and bulky, both must tap a large market nearby, and both require car service throughout twelve months of the year. On this latter account cement plants in the South and West are handicapped because the car tonnage is so much in demand for the movement of crops during a portion of the year. Other similarities between cement and steel are the dependence upon fuel, the heavy investment in plant in proportion to the value of output and the close sympathy between the sale of products and general business conditions. After iron and steel, cement affords one of the best barometers of business conditions; in both cases this is due to the wide use of the materials for structural purposes. The close analogy in so many respects between cement and steel leads to questioning whether cement manufacture will follow the lead of steel by coming under the control of a limited group.

Movement Toward Consolidation

It is sometimes said that this cannot happen because the raw materials are so universally available that potential competition will always offset monopoly. But this easy assumption overlooks the large initial investment required, the necessity for a large market and the importance of cheap fuel. Furthermore, the business is peculiarly mechanical so that patents on rotary kilns or grinding apparatus could easily supply the key to monopoly, and as a matter of fact this movement has gained considerable headway. The margin of profit in the business is small, so success depends upon volume, hence capital is given a strategic advantage. The large companies have already coalesced into a few groups, each under one control, and all the groups have acted together to promote sales and educate users of cement. The industry seems about ready to crystallize into combination. The chief obstacles to this action are not economic factors but personal animosities.

BRICK MANUFACTURE

Process

The two main groups of industries based upon clay as a raw material are the manufacture of bricks and the making of pottery objects. Measured by the total value of products, the number of plants, or the number of workmen engaged, the brick industry is about four times as important as the pottery although the latter is much more spectacular.

Although bricks are composed primarily of clay, they also contain some sand to prevent shrinkage and other materials to act as binders. The binder chosen is the determinant of the color of the brick, generally imparting a red or yellow shade. Until recently almost all bricks were made by hand, the clay, sand, and binder being moulded to the form of a brick in an iron or wood frame. After drying in air or artificial heat the moulded product was fired, using wood, coal, natural gas, or producer gas depending upon which was most abundant and cheapest. Firing served to drive off the water, fuse the chemicals which the brick contained, and also, by the care with which it was done, affected the hardness and color of the brick. Under primitive conditions, the firing-sheds were not permanent and their operation was slow, irregular, and uneconomic, while their product could not be standardized in the slightest degree. These conditions still prevail in most regions where brickmaking is conducted on a small scale. Where the business is more developed, a permanent kiln is installed into which moulded bricks are piled and then fired. Many such kilns are so arranged that the process may be continuous. Wherever they are used the usual fuel is gas.

Costs

In the manufacture of bricks two costs stand out as the most burdensome, one for labor and the other for fuel. Inasmuch as brickmaking is generally a seasonal or summer occupation, it seldom collects a permanent working force but must depend upon "floaters" to carry on the jobs. Lack of continuity of operation added to untrained, ever changing labor, generally results in making brick plants small; for example, the average number of people employed per plant throughout the United States is only 18. The lack of experience or sustained interest upon the part of most of the employees makes the labor cost per thousand bricks comparatively high. The other important cost item is the fuel used for firing. Since the firing takes from 6 days to 2 weeks, the availability, price, and economic use of fuel is an important determinant of the success or of the failure of the enterprise.

Semiarid Regions

Brick manufacture reaches its greatest proportions either where wood is scarce or where density of population makes wood unsafe or structurally impossible. Where wood is lacking, brick or stone become the principal building materials. Babylon, the reigning city of semiarid Babylonia, constructed her palaces, temples, marts, and homes from brick and stone and from the ruins the modern towns of the neighborhood cull bricks for their own use. Treeless Egypt combined utility with art in rendering bricks of service. We are reminded of her industry in the story of the Pharaoh whose exactions culminated in requiring his Hebrew slaves to make bricks without a binder, an order that precipitated the Exodus. In the southwestern parts of our own country, in our own times, the rule holds good that where wood cannot be secured, houses are made of brick. The adobe houses of that region are made from sun-dried clay bricks piled together.

City Markets

In modern times, however, the regions which offer the best market for bricks are not so much those where wood is deficient but the ones where population is massed. Among nations this is seen in the prevalent use of bricks in Holland and Belgium. City contractors have learned that tall buildings cannot be made of wood alone, and city landlords have discovered that wooden dwellings are dangerous fire hazards. London was a city of wooden houses until the great fire of 1666 which showed the fallacy of inflammable material and led to the recasting of London into fire-resisting brick.

In the United States the same truth is also clearly manifested by the strikingly close correspondence between the counties containing our largest cities and the counties reporting the largest brick production. Cook County, Illinois, in which is the city of Chicago, is the largest brick manufacturing locality in the United States. In the East, New York City is the largest market for bricks; consequently we find a concentration of the industry in the Hudson River Valley so that every day barges full of bricks may be seen floating down the Hudson to the metropolis. Water transportation to New

York City along Long Island Sound has made Connecticut also important in brick production. A similar explanation holds good for the brick made at Raritan, New Jersey.

The third most important locality in the manufacture of brick is the region in and near Philadelphia. This city claims to have had the first brick house in America, built in 1633 by William Penn as a gift to his daughter. The house still stands as a historical curiosity in Fairmount Park. The bricks of which it was constructed, however, were imported from Holland. Much of the soil upon which Philadelphia rests is clay, so the city itself contains a great many brick-yards. Its needs are also supplied by other yards on its outskirts. Philadelphia advertises itself as the "City of Homes." The houses that constitute these homes are two-and-a-half story dwellings, built in rows and made of brick. Houses of this type all nearly alike cover acres and acres of ground in West Philadelphia and North Philadelphia. Similar dwelling-houses may also be seen in Baltimore.

Concrete Competition

The brick industry recently received a blow when the popularity of concrete invaded the field so long dominated by brick. After the first decline in the face of this competition, the brick-makers were spurred to great activity in advertising their wares, in improving the quality of their products, and in educating the market as to the usefulness of their commodity. Latterly the advance of concrete has been a direct stimulus instead of a check to brick manufacture, because bricks have been used in connection with concrete to lend it variety, beauty, and mutability.

POTTERY

Early Prejudice

Although pottery is one of the oldest arts, having arisen in Assyria, Egypt, or China, it was not common in the United States until after 1700. The early settlers of this country used wood or pewter household utensils to such an extent that before 1776 very few of the people outside of the largest places had ever seen porcelain. In 1825, however, a few pioneers in the industry began to send out their wares from their kilns in Jersey City and Philadelphia, followed 27 years later by the potters of Trenton. There was so much prejudice, however, against all American pottery objects that the first promoters found the utmost difficulty in securing a market for their wares and for the most part were forced to pass off their commodities as European products by placing English, French, or Austrian labels upon them. The great awakening of pride in American-made goods which came with the exhibitions at the Philadelphia Centennial in 1876 marked the real beginning of pottery manufacture as an American industry.

Five Classes

Of the five classes into which pottery is generally divided, the first consists of white or decorated earthenware of which the most common, ordinary household utensils are made. This group comprises 40 per cent of the total pottery output of this country and in its production Ohio leads by a wide margin, with West Virginia trailing far to the rear, but holding second place. Although chinaware is put in group 2, it requires so much slower, more careful, and skilful workmanship than is possible to secure with the high-priced labor of this country that we have ordinarily been content to import what chinaware we needed rather than manufacture it ourselves. Nevertheless we have developed a considerable chinaware industry in New York and Pennsylvania. Sanitary ware, first developed at Trenton and for which that city is now most famous, comprises the third group. In the manufacture of this ware the United States leads the world. The fourth group is made up of all kinds of porcelain electrical supplies, which with the rapid increase in the popularity of electricity has experienced a notable expansion. Ohio and New Jersey are the centers of this particular type of pottery production.

Rockwood Pottery

The fifth group includes all stoneware, yellow and red earthenware, and Rockingham products. It is the oldest branch of the pottery industry in this country and is now and has been at all times localized in Ohio. One pottery, the Rockwood at Cincinnati, stands out as unique not only in our country but in all the world. This is the only famous art pottery in this country and it is a matter of pride to Americans that it has succeeded by depending entirely upon American materials and workmanship. Beauty, unusualness, and art rather than economy in production or cheapness in price have been the determinants in its development. No printing patterns are used nor are any duplicates made; instead, the individual talent of each worker has been given free rein. As a result, in this pottery there have been invented certain finishes and glazes that have never been imitated successfully elsewhere although the attempt has been made at Sevres, Copenhagen, and Berlin. Certain vases made at the Rockwood Pottery have a fabulous value.

Advantages of Localities

Of the two principal pottery states, Ohio and New Jersey, each has an advantage which the other does not possess. In Ohio fuel is so much cheaper than in New Jersey—costing less than half as much as a rule—that Ohio has been able to maintain first place for most of the branches of pottery manufacture, with East Liverpool as her most intensely localized pottery center. Ohio, too, is near the center of population and hence has easy access to the markets. This factor is especially important in explaining her leadership in the manufacture of drain tile for which the Middle West has a great demand. On the other hand, New Jersey has an advantage in being near the ocean so that she can import by water materials from abroad at a saving of $2 or $3 a ton under the costs in Ohio; so wherever imported material is of consequence, New Jersey may lead Ohio, as she does, for instance, in the manufacture of sanitary ware. Trenton is the leading eastern pottery city.

Inefficiency

In general it may be said that the potteries of the United States are poorly located, badly arranged, and not managed to the best advantage. Too frequent recourse is made to foreign raw materials, whereas with a little study American raw materials could be obtained with a considerable saving. Quite contrary to the usual rule, also, American potteries have made less use of machinery than have those abroad, although our labor costs are higher here than in other nations. The consequence is that the lowest cost of production found in the United States is higher than the highest known in Europe. On the other hand, American manufacturers have a competitive superiority by reason of the custom duties, transportation charges, breakage, and other incidental expenses to which imported wares are subject. Our labor, too, although more costly is more efficient than that abroad and our cheap fuel grants a saving on the average of $1.25 a ton under the fuel charges in foreign potteries. Therefore, despite the disabilities of our potteries, their products can be placed upon the market in direct competition with foreign-made goods, and as a matter of fact American potteries are slowly but surely turning back the flood of foreign goods and grasping the American market for themselves.

Organization of Workers

No discussion of American potteries is complete without pointing out the peculiarly strong position of their labor force. In part, the dominance of labor is due to the circumstance that our business is conducted more largely by male employees than is the case in any foreign plant. In the American potteries, men comprise 80 per cent of the working force whereas in Germany they are 65, in Austria-Hungary 59, and in England 50 per cent. The preponderance of men workers together with the great skill required of potters has led to a powerful labor organization among them, so vigorous and impregnable that the conditions of labor, the use of machines, the limitation of apprentices, and the elimination of female competition are rigidly controlled by the union and not open to free direction by the manufacturers. Although throughout the industry the open shop is nominally recognized, as an actual fact, with the exception of some midwestern electrical porcelain works, most of the plants are 100 per cent union men. In this industry as a consequence, we have the rather unusual arrangement of a national trade agreement between a national association of pottery manufacturers and a national brotherhood of operative potters. There are few industries in this country where labor is sufficiently powerful to negotiate national trade agreements.

Glass Manufacture

Constituents

The only important manufacturing industry using sand as a basic raw material is the making of glass. Glass is manufactured by melting pure sand mixed with a small amount of lead, soda, or lime. Broken glass is frequently added to the raw materials because it hastens melting and thus reduces the charge for fuel. Common glass is composed largely of sand plus lime while plate glass has sand and soda as its chief constituents. The highest grade glass is that which is made from a mixture of sand with lead. In all cases the manufacturing process is the relatively simple one of blending the raw materials, heating them, shaping the molten glass, and cooling it off in such a way that it will not crack nor break.

Wage-Earning "Aristocrats"

Very much like the case of pottery, the glass industry stands out from among others in the importance and power of labor. Since very few machines have been introduced into glass manufacture and inasmuch as its production depends upon the use of great skill, labor is put in a position to dictate. The physical requirements of the manufacturing operations are of considerable importance in restricting the number of men who can perform them. A glass-blower must be active on his feet, strong in his back and arms, able to stand excessive heat, and must have powerful lungs. Since few men can be found equipped with all these capacities, the ranks of glass-blowers are necessarily limited. This has given them such an opportunity to organize and after organization to command their employers that their ranks are still further limited by rigorous union rules. By adjustment of the initiation fee the employees are restricted to men of American birth; by union laws in respect to the number of apprentices the group is prevented from undue expansion caused by teaching a large number of new men the art. As a consequence, glass-blowers have been the aristocrats among American workmen. Their hours have been among the shortest and their wages among the highest.

Mechanical Processes

The very existence of such a condition, however, has stood as a challenge to employers. With the incoming of standard glass products, such as milk bottles, fruit jars, and beverage containers, the way was opened for the introduction of machinery. Of late years there has been a movement therefore toward replacing the old-fashioned, intermittent melting of glass in crucibles with the use of tanks in which glass is made continuously. Furthermore, by the application of moulds and compressed air, the way has been opened for the hiring of less skilled workmen without any physical limitation upon the number of men employed. Already the potency of machinery has begun to be felt and glass-blowers' wages have commenced to sink comparatively. Young men, too, who once clamored and petitioned for admittance into the closely guarded ranks of glass-blowers, now foreseeing the ultimate doom of the long-held monopoly, are turning their energies to other industries. The days of the glassblowers' aristocracy are numbered.

Natural Gas

Aside from the prominence of labor as a factor in glass-making the other most important one is fuel. Originally the only fuel serviceable was charcoal and as long as that was true, a few towns in New Jersey where the glass industry had first started in response to local supplies of high-quality sand were able to maintain their supremacy and their monopoly of skilled labor. Down to 1860 the towns of Millville, Bridgeton, and Vineland, in New Jersey, where the largest groups of skilled workmen were concentrated, were able to keep the business localized in their environs; but with the incoming of first coal and then gas—either of the producer variety or natural gas—and finally with the use of oil as a fuel, the long-time hold of New Jersey upon the glass industry began to weaken. The varieties of glass that called for relatively small amounts of skill were manufactured in regions where fuel was abundant and cheap. This movement has continued until Pittsburgh, advantageously located in respect to natural gas, now holds first rank in glass manufacture. When natural gas was discovered in Ohio and Indiana and when it was learned how profitable the clean, easily regulated gas was for glass-making, these states too began to manufacture glass, until today Muncie, Indiana, is one of the nation's chief producing centers specializing largely in the production of fruit jars.

High-Grade Glass

New Jersey's human resources consisting of highly skilled artisans, has enabled the towns of the state to continue in the business but has forced them to adopt either coal or producer gas as a fuel and to limit activities to the highest grades of glass in which the skill of the workmen counts the most. The possibility of substituting machinery for the manufacture of even these varieties of glass tends to weaken the position of New Jersey and to localize the industry in regions where fuel is cheapest. The movement is somewhat offset, however, by the invention of machinery in the New Jersey plants themselves; for example, during the Great War certain New Jersey concerns invented automatic machines for turning out glass used in chemical industries or laboratories, for which type of glass America before the war had depended entirely upon the skilled, low-priced labor of Germany or Austria. New Jersey for the time being has a monopoly on this business in the United States. In general, the contest between the old-established glass plants of New Jersey and the new ones of the Middle West narrows down to a struggle between the importance of labor and the significance of fuel as factors influencing the business. Labor, long in a position of dominance, is being greatly weakened and fuel is coming to the fore as the principal element to be considered.

Wood Industries

White Pine

Wood is one of the most universal materials entering into American manufacture, outrunning even iron or steel in the variety, range, and interest of its uses. Only food products have a greater influence on an American's life than the things manufactured from wood. Where the wood comes from, why certain woods are employed for special purposes, and what other materials may be substituted for wood are questions requiring answers.

Not all trees are cut and sent to the mill in the same way because in different sections of our country the topography, the climate, and even the trees themselves are so dissimilar that each forest region has its own method of handling the timber and logs. The tree that is most famous in New England is the white pine. This same tree is found in all the northern states from Maine to Minnesota and is cut, transported, sawed, and marketed in all of them by methods that are essentially the same.

In the heart of the forest, log camps are set up, from which the lumberjacks go to their work of felling. The camps are temporary because work in any one district is limited by the number of trees in that vicinity. When the local supply is exhausted the camp is abandoned and another one built at the new source of supply. These northern camps, too, are occupied only in the winter season, for all the logs are hauled by sleds over the snow to the main line of railway or to the river that carries the logs to the sawmill. The dependence upon snow transportation limits the usefulness of the camps to the winter. In spring, when warm rains and melting snows flood the streams, the logs are shoved into the current and are carried by it to a mill where they are transformed into lumber, matches, or spools, or into wood-pulp for the manufacture of paper.

Yellow Pine

When one passes from the North Woods to the yellow pine forests of the South Atlantic coastal plain, winter snows and spring freshets are conspicuously absent; consequently the logs cannot be carried by sleds or floated down streams but instead are transported by crude logging railroads. In place of the picturesque log-sled, the southern forester makes use of a stationary steam engine to which is attached a long cable. This cable is drawn out and fastened to the log which is then hauled to the place where the engine stands. From this point, the logs are loaded upon railway cars and transported to the mill. Since the mild climate permits work all the year round, the camps are more permanent and partake of the nature of frontier towns. Men take their families with them and enjoy a simple but wholesome home life. In some places the whole camp is on wheels, that is, box cars are fitted out like houses and when the timber of one section is all cut, the entire camp is coupled to locomotives and pulled to the next cutting area.

Cypress

In the cypress swamp forests along the Mississippi River, yet another method of logging is employed. Here canals are cut through the swamps and a stationary engine set upon a boat is placed at the point where the canals converge. When the tree is cut, it is first dragged to the canal by small stationary engines and then pulled down the canal by another engine on the large boat. The work is carried on throughout the year and whole families live in the camps. In this case the entire camp is afloat, for all the employees live on house-boats two stories high. Since the work is in a warm, humid region, and the actual homes are in swamps, white men as a rule cannot stand the conditions, hence the working force is usually made up of negroes.

Out upon the Pacific Coast and also in the Rocky Mountains, the precipitous mountainsides and narrow, crooked, deep gorges prohibit the use either of horses or railroads in carrying logs to the mills. In these regions board troughs are built down the mountains, across ravines, and around the spurs of hills; in these water-filled troughs, called "flumes," the logs are carried from the high places where they are cut to the mills in the valleys where they are sawed into lumber.

Sawmills

Whether the logs come from the snow-filled woods of New Hampshire, the sandy plains of Georgia, the swamps of Louisiana, or the summits of Washington, their treatment in the mills is essentially the same. The logs are brought into the mills by mechanical carriers—chains as a rule—and drawn under a saw that cuts off the bark. They are then rolled onto frames that run under a whole battery of thin, keen, double-edged saws that with one operation slice the logs into boards. These pass to a drying-yard where they are piled to season, or are put into artificially heated chests where they are quickly dried.

Mills originally were small and therefore could be moved from time to time as the near-by forest became exhausted. But the modern tendency for large-scale operation and the utilization of machinery has brought about such an enlargement that the modern mills cannot be changed from their original location. Their owners have become timber-culturists as well as timber-cutters. For every tree that is felled a new one is planted. Moreover, every scrap of material about a mill, even to the sawdust and the bark, is made to serve some useful purpose.

Wood Manufacture

The manufacture of wooden commodities from the lumber turned out by the sawmills, is carried on in all types from clothes-pins to pianos by analogous methods, sawing, planing, lathe processes, glueing, polishing, and assembling comprising the essential operations. The industry, however, falls into two groups, one in which skilled craftsmanship plays the most important part, and the other where volume of output from automatic machines is the principal characteristic. Wood-carving and cabinet work illustrate the first, while the manufacture of matches or spools may be taken as typical of the second. Of the former the articles tend to be manufactured where they are used, partly because their high value limits their sale to large communities, and partly for the reason that it is cheaper to ship carload lots of lumber than it is the bulky, easily broken, completed commodities. Nearly every city has its needs fulfilled by its own group of skilled men.

Even in this branch of the business, machinery has displaced men to such an extent that a few communities are becoming famous for particular products, and by transporting them in the "knock-down" condition to distant markets, have largely superseded the older local industry in each consuming center. In this way Grand Rapids, Michigan, Sheboygan, Wisconsin, several towns in Indiana, and Gardner, Massachusetts, have attained fame for their wood-working factories. Of the second group of plants dependent upon automatic machinery, the most important considerations are abundant and cheap raw materials plus cheap power. The factories as a result are located as near the forest as possible and at a convenient water power site as a rule. Since the product is usually small—clothes-pins, rolling-pins, spools, matches, and the like—and can be closely packed, distance from the market is not an elementary consideration. As machinery dominates the entire industry more and more, the distinctions based upon craftsmanship disappear while raw materials or markets become the important elements.

Special Uses

What becomes of the lumber when it leaves the mill-yard is determined by the nature of the board itself. Certain qualities found in particular woods fit them for specific uses. The durability of cypress—the wood eternal—and of chestnut, oak, or mesquit, make them highly desirable for the frames or outside finish of dwellings. On account of their strength white or yellow pine are used for bridges and other places where heavy burdens must be carried. The resistance to bending found in white oak, fits it for columns or pillars. Furniture requires a wood that is hard, non-shrinking, and capable of taking a high polish. Mahogany, oak, chestnut, walnut, maple, and pine all possess these qualities. Since for furniture, too, beauty of grain is an essential feature, we find the unusual, distorted grain known as "bird's-eye," sometimes discovered in maple, makes it highly prized for beds, chairs, or bureaus. Hickory's toughness marks its place as a wagon material, while the elasticity of ash makes it desirable for shafts or athletic appliances. The color of ebony, the odor of sandalwood, the fire-resistance of California redwood, the freedom from insect pests noticeable with red cedar, all these are peculiar qualities that determine why each of these woods is sought for special uses.

Chemical Elements

In addition to the foregoing, many woods contain chemical elements that are of industrial significance. Thus the bark of oak and hemlock are rich in tannin and so have been employed for years in tanning hides or skins into leather. Sumac is utilized for a like purpose. Other woods have the property of acting as coloring agents, hence are used for dyeing leather and cloth.

The osage-orange, barberry roots, and the inner bark of the black oak yield a yellow color, while red gum gives purple and the flowering dogwood red. Logwood is used for black, and butternut became famous in the "butternut jeans" of Confederate soldiers at the time of the Civil War.

Forest Exhaustion

One of the best all-around woods possessing a combination of the most desirable qualities was realized in white pine, the characteristic tree of all the northern states east of the Mississippi River. When the first settlers located in New England, the white pine was so abundant that it was a real menace to farming. The pioneers were forced to cut the trees in order to clear the land for crops. The cutting continued after the Revolution until the New England supply was almost exhausted. This fact gave wood users little concern, however, for as each eastern state in turn saw its forests fall before the ax and saw, a newer untouched resource was brought into the market from our more western states.

Men gave no heed to the results of this policy until the forests of Michigan, Wisconsin, and Minnesota were nearly gone; then they were brought up short before the fact that the prized white pine had been cut off almost entirely. Something akin to a mental revolution passed over the nation when it realized that its supposedly limitless forests really had a limit, and for the first time we feared for the future. White pine was gone; unless care were taken, the other trees would disappear in the same way. From this shock came two results: one, the conservation movement; the other, a rising price for lumber.

Conservation

The conservation movement was a recognition of the fugitive nature of our national resources. Beginning with the desire to save forests for the coming generations it was applied also to coal, iron, copper, petroleum, natural gas, and water power—in fact, to all our natural resources. So far as forests were concerned, the movement was effective in forcing the government to withdraw vast tracts of forest land from private use or exploitation in order to make the best present use of timber and to insure a supply for all time to come. With the disappearance of white pine, lumber operators foresaw that if they were to continue in business they must buy tracts of forest land and hold it for future cutting. Almost a panic seized the lumbermen and they purchased timber land right and left throughout the South, the Rocky Mountains, and on the Pacific Coast. These purchases together with the government reserves forced the price of stumpage beyond any point hitherto reached. This situation reacted upon the price of lumber, causing it to rise sharply in response to the prospective shortage of supply.

Substitutes

As long as lumber was cheap, no search was made for substitutes, but when its price advanced, that investigation began. It was quickly proved that wood was not indispensable but that many other materials of perhaps superior serviceableness could be secured. As a consequence, steel has been used for furniture; concrete for structural purposes; paper for boxes or crates; wire instead of wood has come into favor for fences; iron or concrete for posts and poles; asbestos, slag, slate, and tile replace wood shingles; metal lath and windowcasings appear where wood was once always first choice; metal automobiles are the successors of wooden buggies; and iron ships have driven the wooden vessel almost from the seas. In fact, for all its important uses, wood now has a competing substitute and even where wood is retained it is often not employed in the solid form but in thin sheets called veneer. Substitution is proceeding rapidly. It already accounts for nearly a fourth of the lumber formerly cut and since most of the change has occurred within the last 15 years, we may expect an even greater relative decline in the use of wood in the future.

FOOD PRODUCTS

Simple Processes

Judged by the value of products the industries that prepare food lead in America's manufactures, but this fact gives an altogether misleading impression of their importance. Their value is largely that of the raw materials because the manufacturing operations add but little to their worth. In general the manufacturing processes are simple, using machinery operated by unskilled labor. In most cases perishable raw materials are treated in such a manner, usually by drying or canning, that they can be preserved indefinitely. Therefore the factories are as widely scattered as the raw materials and consequently are conducted upon an exceedingly small scale. This is generally true in regard to canneries, whether they be for tomatoes near Baltimore, for corn in Maine or New York, or for salmon along the Columbia River.

Meat-Packing

There are at least two exceptions to this rule; meat-packing is a large-scale business, and so usually is flour-milling. Meat-packing is a big business because it is most economically transacted where it may employ the principle of the subdivision of labor. Furthermore, an added profit is obtained if by-products are manufactured where they are produced. To run a business in this way requires a large investment of capital, hence meat-packing is not conducted for the most part in small plants. The industry is localized at Chicago because that city is nearest the corn and grain belts where the animals are fattened. It does not pay to ship live cattle or hogs to eastern markets to be slaughtered because they lose weight for every mile of travel. Instead, the animals are sent the short journey to Chicago where they are killed; meat and preserved products then are shipped to the eastern market. Slaughtering is done in a large way at Chicago rather than in a small way upon the farm because Chicago can draw upon a wide area and hence need never lack for raw material. Furthermore, in a large city the labor necessary to run the plant is easily obtained. Meat-packing differs from most food industries in that it is a large-scale business highly centralized.

Flour-Milling

Flour-milling is likewise an exception. In this case machinery plays a large part in the manufacturing process. Consequently the industry utilizes considerable capital, a fact that tends to make it relatively large scale. Flour is most closely associated with the city of Minneapolis, because that city is a central point in the grain-growing area on the edge of the greatest spring-wheat section in America—the Red River Valley of Minnesota, North and South Dakota, Manitoba, and Saskatchewan—and possesses an admirable water power site. Since the railroads, too, charge a relatively higher rate for the shipment of wheat than of flour, this tends to reduce the distance that wheat travels and extends the journey of flour. In other words, flour is made usually as near the wheat fields as possible.

All food industries tend towards large-scale operation in order to gain economies in manufacture and distribution and also to eliminate the chance for failure. The raw materials fluctuate greatly from year to year so that the risk of loss is great for a small plant. A large one can equalize its losses over a long period of years and so withstand a bad season. The present-day typical small food plant therefore bids fair to be replaced by larger operations.

SHIPBUILDING

The Yankee Clipper

Although all the thirteen colonies had access to the sea, in none of them was the influence of tide-water so potent as in the New England settlements. Since the middle and southern colonies were better endowed with agricultural wealth than New England tillage of the soil was their foremost activity. New England alone, poor in farm produce, turned from the soil to the ocean where fishing and commerce became the sources of her greatness and gave rise to almost all of her other activities. Within a year of the founding of Boston the first ship, the "Blessing of the Bay," was upon the stocks, and from that time until the Civil War shipbuilding was one of the most familiar occupations in New England.

The white pine that covered the region was especially adapted to sea service because it was buoyant, staunch, and cheap. English oak was heavier, and Baltic fir was more expensive; there was no wood that could compete with New England pine. In 1791 the cheapest construction in France cost $55 to $60 a ton, whereas in New England ships could be built for $33 to $35 a ton. The pine was largely used for masts and sheathing while the equally abundant white oak was the favorite for frames on account of its sturdiness. With the sea at their doors, with the coast full of indentations ranging from coves to great roadsteads in the larger bays, and with fishermen or merchants calling constantly for more craft, it is no wonder that shipyards flourished. In 1760 American yards were turning out yearly from 300 to 400 commercial boats and a host of less important ones such as dories, sharpies, and small sailboats. Before the Revolution, out of a total population of approximately 3,000,000, there were no less than 4,000 men engaged in shipbuilding.

The demand for boats was immediate and continuous. American ships were light in weight, speedy in sailing, staunch in seaworthiness, and withal cheap to build. Europeans as well as Americans recognized the good qualities of Yankee schooners or clippers, so our shipyards grew apace. When European wars afforded us the opportunities to capture a goodly share of the world's carrying trade, every accession of commerce was reflected in the pressure put upon shipyards to turn out more vessels. The American yards hummed with activity until the Civil War.

The Iron Steamship

Unfortunately for us there came a change. The world learned how to build ships of iron and later of steel so that wood was discarded. Just so long as sailing vessels made of wood were the carriers of the world's goods, our resources gave us an advantage over other nations, but when steam-driven iron ships became the rule our shipyards sank into ruin. We had an abundance of the best wood, but of iron-making we were densely ignorant. Great Britain led the world then in iron production, hence New England pine or oak went down in defeat before Clyde River iron. In 1910 Britain owned six times as much tonnage merchant marine as the United States. Only coastwise lake and river vessels reserved to American builders by federal law occupied the attention of American shipyards.

The Great War

But again the forces that control industry have shifted. The Great War with its accompanying submarines put a premium upon ocean-going boats. America, by 1915, had attained the foremost position in the world's iron and steel industry, so when the war demand arose we of the United States were able to satisfy it. Shipyards once more were put at the front of America's industries. Since the new vessels were constructed from iron rather than wood, new yards near the ironmills rose to prominence. New England's yards, founded upon wood as a building material, could not compete with the iron-using plants of the Delaware River, New York Harbor, or Newport News. The Delaware, in touch with the great blast-furnaces and rolling-mills of Pennsylvania and by nature a wide, deep estuary stretching inland 102 miles from the sea, thus affording protection, became for the time being the greatest shipbuilding center in the world. America possessed the steel; she was endowed with good, natural waterways; all that was needed was a uniform, great demand to call back to life her shipbuilding. Ships are cheapest when built like Ford cars, in large quantities with standard parts. The Great War gave just that kind of a demand. In response, America has come back as one of the principal shipbuilding nations in the world.

CLOTHING MANUFACTURE

The Sewing Machine

Originally nearly all clothing was made either in the home or by custom tailors. Tailoring, however, is a business subject to violent fluctuations in demand, so in the off seasons it was customary for master tailors to employ their journeymen in making clothes for sailors or frontiersmen, neither of whom were particular about style or fit. All work of course was laboriously accomplished by hand.

No progress toward ready-to-wear clothes was made until 1850 when the sewing machine was invented. This machine had the effect of still further concentrating the work of tailoring because fewer men could turn out more suits in a shorter time. The future looked dark indeed to tailors who worked for others because the machine not only threatened their hand skill but piled up the year's work in a few short weeks in spring and fall.

Size Standards

The Civil War brought the solution of the problem. In measuring thousands of soldiers for uniforms it was discovered that nearly all men who have a 40-inch chest, have also 36-inch waist and legs 31 inches long on the inseam. For every chest size there are corresponding waist and leg sizes. This uniformity of men gave the basis for factory operations because factory products must approach standards. During the war therefore our first ready-made clothing factories appeared. In the beginning they confined their attention to uniforms, but by degrees they learned that the rules applicable to soldiers' clothes might be utilized for civilians as well. Experience brought refinements in the measures; as, for instance, it was soon discovered that the fat men and the thin men had a sort of standard fatness or thinness so that clothes could be turned out by hundreds and yet fit the class of men for whom they were intended. Beginning with the cheaper grades of clothing, factory products have gradually invaded the market, driving out the more expensive tailor-made suits. Today by far the majority of men and boys are clothed in suits that come from factories.

Subdivision of Labor

The collection of many tailors under one roof gave rise to the subdivision of labor, a principle that now is carried so far that the crudest, most unskilled, illiterate person can be taught easily the simple job he is required to perform. This feature of clothing manufacture is so marked that it centers the industry where population is most dense and varied. The most important production centers for clothes today therefore are New York City, Chicago, Baltimore, Philadelphia, and Rochester. These cities also offer the advantages of accessibility to market

CLOTHING MANUFACTURE—MEN'S

Per Cent of United States Total

City	1919	1914
New York	38.4%	34.7%
Chicago	15.0	15.2
Baltimore	6.4	6.9
Philadelphia	5.1	5.3
Rochester	3.3	3.6

and ready response to subtle style influences. The output of men's clothing in each of these cities compared with the country's total in 1919 and 1914 is shown in the table on page 298.

Women's Clothes

The manufacture of women's clothes was for a long time kept out of factories because the shift in styles was so rapid as to defy factory operation. Standard output is a necessity for large-scale operation. Frequent shifts in style eliminate the possibility of standardization, hence women's clothes shops are small because a small plant is more flexible and sensitive to style fluctuations. Losses too are more widely disseminated and thus more easily borne. The chief centers for the manufacture of women's garments are New York, Philadelphia, and Chicago, which contributed the following proportions to the country's total production in 1919 and 1914:

CLOTHING MANUFACTURE—WOMEN'S
Per Cent of United States Total

City	1919	1914
New York	69.3%	71.7%
Philadelphia	7.8	7.2
Chicago	4.1	4.1

The typical factory for men's clothes is a great plant, for women's, a small factory. The custom tailor is found today only in the larger places and his clientele is confined to the well-to-do section of the population, and even here the high-grade, ready-made garments are making more serious inroads on his business. Some idea of the growth of the clothing manufacturing industries since the middle of the last century may be secured from the following table:

Increase in Clothing Manufacture

Year	Value of Product Men's	Women's
1849	$48,312	......
1859	80,831	$7,181
1869	148,660	12,901
1879	209,548	32,005
1889	251,020	68,164
1899	276,717	159,340
1909	485,677	384,752

Labor Movement

In 1920, the men's clothing industry became the exemplar of the modern labor movement, inasmuch as the whole trade in so far as labor matters were concerned was controlled by a joint council of workers and employers. Organized on the basis of the whole plant, industrial unionism instead of the older system of craft unions, the Amalgamated Clothing Workers of America, beginning as secessionists from the American Federation of Labor and after many bitterly contested struggles, finally emerged as the most powerful factor in the industry. This led the relatively weak employers to organize in self-defense.

Since the industry was localized in New York, Chicago, Baltimore, Rochester, and Philadelphia, the uniting of employers offered no insurmountable obstacle and was accomplished in 1920. In each city a single man was appointed to represent all the employers in all labor adjustments, and these men together constitute a board for the entire country. The union represents the workers so that its officers in dealing with the Labor Manager Board of the employers, constitute a joint council in which all labor matters are definitely and peacefully decided. An impartial board to hear disputes is set up in each city by agreement between the Labor Managers and the union officials. In Rochester, the union has even taken over the entire management of certain shops contracting with the employers for the production of vests, the former employer confining his activity to buying, selling, and financing. The entire scheme is unique in American industry although somewhat similar arrangements have been made in several English industries notably the building trades and potteries.

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CHAPTER XII

SOME EFFECTS AND TENDENCIES OF MANUFACTURING IN AMERICA

Effects

It is unscientific to select one of the many interrelated factors influencing a given situation and attribute all the effects of the combined factors to the one discussed. Our manufacturing has been so entwined with our growth in population, internal improvements, agriculture, and mining that it is difficult to attribute exactly the effects of manufacturing upon our national development. Yet it is evident that the growth of factory enterprises has been responsible in a large measure for the change in the distribution of population from rural to urban environment, and that the increased racial complexity of the population is due most frequently to the demand for foreign laborers on the part of factories. Although there is little statistical proof for the changes that have taken place in the character of the American people brought about by the physical distribution or composition of the population, it seems clear that to manufacturing may be attributed the trend from conservatism to radicalism, and from habits of frugality to spendthrift ways. While it is true that the expansion of manufacturing has been dependent upon the discovery of natural resources it is equally true that the growth of manufacturers has hastened the exploitation of these resources and the progress of all other industries.

Early Cities

The most striking influence of manufacturing upon American life is generally conceded to be the attraction of a larger proportion of the population to city life than was the case before manufacturing by machinery outside the homes began in earnest. This universally recognized fact is capable of definite demonstration. Before the drawing up of the Constitution there were only seven cities in America of more than 8,000 inhabitants—Philadelphia, New York, Boston, Charleston, Baltimore, Salem, and Newport. All of these attained their growth through commerce. Of the seven, Philadelphia alone showed any early marked tendency toward manufacturing pursuits. As long as Philadelphia was engaged primarily in commerce it lagged behind Boston in population, due doubtless to the latter city's earlier start and more accessible location; but in 1750, when Philadelphia began to acquire fame for the products of its mechanics, it forged ahead of Boston in numerical importance. By 1790, 45 per cent of Philadelphia's population was employed in mechanical pursuits.

Philadelphia maintained its national premiership until the Erie canal gave New York the greatest commercial advantage over any other city in the country and pushed it to the forefront in population. After New York passed her in gross numbers Philadelphia took no great spurt forward until 1860 when again her population increased rapidly. It is significant that the later period of growth occurred simultaneously with the rapid expansion of manufactures, especially wool and iron.

Urban Population

Viewed from a slightly different angle of national rather than individual city achievements it can be shown that in the 90 years between 1730 and 1820 the proportion of the total population dwelling in cities underwent no appreciable change. In 1730 the proportion of urban to total population was 4.6 per cent. In 1820 it stood at 4.9 per cent. Beginning in 1820, at which time manufacturing became noticeable, the urban rate has risen sharply, changing from 4.9 per cent in 1820 to 46.3 per cent in 1910. In 1790, 9 men of every 10 were engaged in agriculture; in 1910 only 3 men out of every 10 were so engaged. In the industrial states the concentration in cities exceeds that for the country as a whole by a considerable margin; for example, the population is more than 75 per cent urban in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Delaware, and more than 50 per cent in Pennsylvania, Ohio, New Hampshire, and Illinois, as shown in the table below:

PERCENTAGE OF URBAN POPULATION—1910

State	
Rhode Island	96%
Massachusetts	92
Connecticut	89
New York	78
California	61
New Jersey	75
Illinois	61
Pennsylvania	60
New Hampshire	59
Ohio	55

The only other states whose urban population exceeds 50 per cent of the total population are Colorado, Washington, and California, each of which, although outside the industrial area, is the principal industrial state of its region. Of the 50 cities in the United States in 1910 counting more than 100,000 souls, 31 were in the industrial area east of the Mississippi and north of the Ohio and Potomac, leaving but 19 to the non-industrial sections. The region just outlined wherein manufacturing predominates, although comprising but 7 per cent of the total area of the United States, contains 29 per cent of the total population of which one-half to nine-tenths live in cities. From these statistics it is sufficiently evident that the general impression or observation that manufacturing has shifted our population from the country to the large places is borne out by the facts.

Foreign Population

Next to this change in the distribution of population accompanying a reapportionment of men in industry, the principal social influence of manufacturing has been its effect upon the racial composition of the American people. Instead of a homogeneous group with which our colonies started we have become a heterogeneous nation in which change our prominence in manufacturing has played no small part. At the time of the Revolution the colonists were drawn almost entirely from British stock; with the exception of a small admixture of Dutch in New York and a larger proportion of Germans in Pennsylvania the colonies were mostly filled with people of English or Scotch birth or descent, as the following figures for the year 1790 show:

RACIAL COMPOSITION OF THE UNITED STATES—1790

English	83.00%
Scotch	6.00
German	5.60
Dutch	2.00
Irish	1.60
French	.50
Hebrew	.01
All Others	1.29

In the same year the racial composition of several of the states was as follows:

RACIAL COMPOSITION OF FIVE STATES—1790

State	English	Scotch	Dutch	German	All Others
Massachusetts	95.0%	3.6%	..	..	1.4%
Rhode Island	96.0	3.0	..	..	1.0
Connecticut	96.2	2.8	..	..	1.0
New York	78.0	3.0	16%	..	3.0
Pennsylvania	59.0	11.0	..	26%	4.0

At the present time New England's foreign population is derived from diversified sources. The largest group is the Canadians—largely French Canadians. They are followed by the Irish, Russians, Italians, English, Portuguese, and Greeks. In the Middle Atlantic States the principal contributions to the population have come from Russia and Austria-Hungary, with Italy, Germany, and Ireland furnishing large quotas. In the Middle West, Germany, Russia, Austria, and Sweden have supplied the greatest share of the population that is either foreign-born or of alien parentage. That the newer racial elements are associated with manufacturing is indicated by the fact that the center of foreign population for 40 years has been north and east of the center of the total population. But the connection between manufacturing and racial complexity is more clearly established when a careful investigation of the manufacturing states is made.

Distribution

The percentage of people whose parents were born in this country is lowest in New England (39 per cent) while the percentage of those belonging to families in which one parent was born abroad (31 per cent) or who were themselves immigrants is highest in New England (27 per cent). A study of cities demonstrates this yet more clearly. It was pointed out above that the large cities (over 100,000 inhabitants) were most closely identified with the manufacturing area, therefore the relation between manufacturing and racial composition may be manifested by the conditions in these centers. Of the 50 largest cities only 14 have as much as one-half of their population made up of people whose parents were native Americans; in 22 less than a third could make this claim. In many of our most famous manufacturing cities from a third to a half of the population were actually born outside of the United States, as is disclosed by the figures in the table which follows:

PERCENTAGE OF FOREIGN-BORN WHITE IN CERTAIN CITIES—1910

City	
Fall River, Mass.	42%
Lowell, Mass.	40
New York, N. Y.	40
Paterson, N. J.	36
Boston, Mass.	35
Chicago, Ill.	35
Bridgeport, Conn.	35
Cleveland, Ohio	34
Providence, R. I.	34
Detroit, Mich.	33

Although nearly all of the manufacturing cities contain representatives of all the nationalities that are present in the United States most of them have some one or two nationalities that lead the others. For example, Germans are conspicuous by their number in Baltimore, Buffalo, Chicago, Cincinnati, Detroit, Jersey City, Milwaukee, Toledo, and St. Louis; Boston and Bridgeport are famous for their Irish; Cleveland has a large Austrian colony; Minneapolis and Worcester are marked by their preponderance of Swedes; New Orleans, Lawrence, and Paterson contain many Italians; New York has a great Russian population; Portuguese and Poles throng New Bedford; and Irish, Greeks, and Austrians compete for supremacy in numbers at Lowell, Massachusetts.

The simple uniformity of British affiliation, normal in all the states 150 years ago, has given way to a condition where less than a third (31 per cent) of our people claim English as their mother tongue. Over a quarter (28 per cent) first learned Teutonic languages and from 10 to 15 per cent speak Latin, Greek, Slavic, or Scandinavian with greater facility than the English language.

While it is true that our whole continent and every industry has shared in the tide of immigrants, yet it remains a fact that the flow has been stronger into those states and cities where manufacturing is most important, for 70 per cent of the foreign-born are in the area specializing in manufacturing. Shops, factories, and mills have supplied jobs to immigrants, and they in turn have furnished an abundant relatively cheap labor supply to our manufacturers. The great number of immigrants pouring into our country from nearly all other countries has changed America from a British offshoot into a nation welding a unique new stock from many diverse sources.

Illiteracy

By fostering a large immigration to the industrial area manufacturing has had the effect of lowering the general average intelligence through the influx of the uneducated which has both a direct and indirect influence. There is more illiteracy among the alien population of the industrial states than among the natives of those same states. The children of foreign-born parents leave school earlier than those of natives and the schools are poor in industrial towns whose factories are not diversified or whose plants use a goodly proportion of semiskilled and unskilled labor. In industrial centers also the schools are apt to specialize upon manual training or technical education rather than upon cultural subjects. Since the foreign population is large in the manufacturing centers the total amount of illiteracy there is serious. Clear evidence of this is shown in the following figures:

PROPORTION TOTAL WHITE POPULATION 20 YEARS OF AGE IN SCHOOL—1910

States	Natives	Mixed	Foreign
New England	13%	6.0%	3.5%
Middle Atlantic	9	5.5	3.0
North Central	9	5.0	2.5

ILLITERACY—1910

States	Natives	Mixed	Foreign
New England	.7%	1.3%	13.8%
Middle Atlantic	1.2	.8	15.8
North Atlantic	1.7	.9	10.0

If we could assume that this illiteracy would pass away with the first generation of immigrants we could view the problem more hopefully. Although the children of immigrants are compelled to go to school and therefore are not completely illiterate nevertheless even the second generation leaves school early and its education is deficient in quantity.

Educational Facilities

That the quality of the education is also low in many manufacturing cities is indicated by the table of per capita expenditures for schools and for libraries, which is as follows:

PER CAPITA EXPENDITURES FOR EDUCATION

Diversified Industries

City	For Schools	For Libraries
Salt Lake City	$8.18	$.22
Everett	6.98	.54
Springfield	6.28	.54
Kansas City	5.70	.19
Worcester	5.39	.37
Hartford	5.25	.14
Providence	4.48	.13
Lowell	4.48	.23
U. S. average	4.70	.25

Specialized Industries

City	For Schools	For Libraries
Brockton	$4.81	$.27
Paterson	4.53	.18
New Bedford	4.05	.38
Lynn	3.97	.21
Fall River	3.95	.19
Lawrence	3.87	.26
Bridgeport	3.43	.24
Waterbury	3.21	.25
Reading	2.96	.10
Wilmington	2.68	.14
Manchester, N. H.	2.34	.15
Norfolk	2.15	.08

As cities rarely spend more money on their schools than their citizens actually demand, a small payment per capita is a sign of a lack of desire for good educational facilities.

How hundreds of communities throughout the country have organized against child labor and illiteracy is told in a bulletin "Every Child in School" issued by the Children's Bureau of the United States Department of Labor in December, 1919. This bulletin describes the methods and results of the "back-to-school" and "stay-in-school" campaigns carried on during 1918 by 44 states and the District of Columbia under the auspices of the Children's Bureau and the Council of National Defense. A large proportion of these states have continued their efforts to stamp out child labor because they have become "aware of the waste of early employment and are recognizing the fact that many children begin their working lives with only a scant educational equipment and before they have had a chance to develop physically." As a result, school-time has been prolonged in many communities for boys and girls who might otherwise have had their education cut short.

The back-to-school and stay-in-school campaigns have shown that in many places school attendance and child-labor laws are not enforced. Many children were found to be working in violation of the statutes of their states, and many children of school age were in factories because there was not a sufficient number of attendance officers and factory inspectors to keep them in school and out of industry. In one state it was found that 10,895 children did not go to school at all in 1918. In a single district an inspector reported 1,700 children as not having had a day of schooling. In many rural districts the children attend school only about half time and the hours for rural schools are very short.

It is conditions such as these, the bulletin points out, that make the United States eighth instead of first on the list of civilized countries with regard to the proportion of literacy among its citizens. One out of every twenty adults living in the cities in the United States cannot read or write; one out of every ten country adults is illiterate.

The bulletin further states that the million or more children who leave school each year to go to work are not all forced into work by poverty. Many of them go to work because they do not realize the advantages of education or because there are not any schools to go to. In one state the committee in charge of the back-to-school campaign found that there was a serious shortage of schools in towns and cities. It was estimated that if all the children who should be in school were there, 40 per cent of them would have to stand. Some localities have reported schools closed for lack of teachers, and it has also been reported from all over the country that teachers were leaving schools for better paid work. Several states met this situation during 1918 by securing legislation establishing a minimum salary of $1,000 to $1,200 for teachers, but school teachers in many parts of the country are still receiving as little as $40 a month.

But legislation for compulsory school attendance or for higher salaries is not a complete remedy, says the bulletin. Schools must be made "so plainly attractive that boys and girls will want to attend. The results of the back-to-school drive indicate that the majority of children leave school because they are not interested and that the school fails to provide the training which meets their needs. If we are to keep children from going to work too early in life we must provide a schooling which holds their interest, satisfies their need, and gives them a sound foundation on which to build their industrial life when the proper time comes for them to enter industry."

The trend toward technical trade-schools has both its good and its bad features. In so far as they prepare boys and girls to follow successfully a chosen occupation, and by the amount they serve to improve the capacities of individuals already engaged in industry, they serve social welfare; but when they are developed to the exclusion of cultural schools and well-nigh compel young people to follow certain activities and prevent the opening of opportunities for other types of training they are contrary to public good. These problems are most pressing where the prevalence of a large alien or mixed population dependent on factories makes their needs most acute.

Radicalism

When we turn from the influence of manufacturing upon the distribution of population or its composition (both capable of statistical measurement) to the effect of manufacturing upon character, we deal with factors that cannot be gauged by figures but are determinable chiefly by their fruits. Based upon such grounds, it appears that manufacturing has converted us from conservatism to radicalism. As a class farmers are everywhere conservative; they are capitalists; they are accustomed to self-dependence; they deal with the slow movements of nature; they are removed from the most hurried currents of life; they are in little danger of actual starvation; and increase in density of population enhances rather than reduces their chances for successful livelihood. Therefore farmers in general resist social upheavals, and since 9 men of every 10 in 1790 were farmers the sentiment was essentially conservative.

On the contrary, manufacturing creates a wage-earning class constantly becoming more dependent on the initiative of others. The wage-earners are faced with abrupt changes in working conditions and even with sudden complete elimination of the need of their services through inventions; the fear of want dogs their heels at all times, and their life in the centers where the currents run swiftest and crowding produces misery makes them look to social rather than individual adjustments to alleviate their conditions.

Social Reforms

Out of the needs and desires of the working population have sprung many of our recognized reforms. The abolition of medieval imprisonment for debt has been brought about by the unremitting efforts of workers upon whom the system pressed the hardest. Men have been jailed in America for a debt of 25 cents; and in nearly all cases of imprisonment for debt the loss of earning power or the piling up of costs has more than equaled the original sum involved. Yet not all the states have remitted the system. Connecticut, for example, still clings to the old custom. Another reform, radical in its time and opposed by the "solid" elements of the community but sponsored by the working people, was the system of free schools and later free textbooks. Those who could afford to send their children to private schools, those who had no children, and farmers outside the larger places objected to being taxed in order to educate the masses; but workers pressed their point that a democracy depended upon intelligent citizens and that since their wages did not permit an education that was a luxury it was the duty of the public to provide opportunities for every child to learn at least the rudiments of knowledge free of charge. At length the wage-earners won and public schools have become a cornerstone of our success as a republic.

Other Movements

Similarly the movements for shorter working days, at first from sunrise to sundown, then 10 hours and later 8; the agitation for state insurance, employers' liability and workmen's compensation acts, and child labor laws; the guarding of dangerous machinery; the installation of public employment offices; the establishment of a minimum wage; and the elimination of death-dealing raw materials; all of these originated with the workmen themselves and were generally passed, first in the most typical industrial states and gradually extended to others where manufacturing was not so pre-eminent.

Every advance has at first been labeled as a radical demand but at length accepted and finally espoused by the groups considered conservative; one generation's radicalism becomes the bed-rock of the following generation's conservatism. Since each generation has its own radical programs and inasmuch as these are supported largely by the wage-earning classes, and because the wage-earners in manufacturing constitute a third of all the men and women gainfully employed in the United States, this aggressive group has helped swing the country away from the conservative policies into what seem like radical ones when they are proposed. The number employed in each of the principal occupations in 1910 was as follows:

OCCUPATIONS—1910

Agriculture	12,659,203
Minerals	964,824
Manufacturing	10,658,881
Transportation	2,637,671
Trade	3,614,670
Public Service	459,291
Professional Service	1,663,569
Personal Service	3,772,174
Clerical	1,737,053
Total	38,167,336

Extravagance

A less commendable effect of manufacturing upon American character has been its influence towards breaking down the Puritan habits of frugality and substituting the manners of spendthrifts. So long as every household had to depend upon its own resources it was careful that its consumption did not outrun its supplies. To do so meant want or death because one household's shortage could not be offset by another's plenty. When merchandise had to stand a transportation charge of $15 a ton and the limit of overland haul was 150 miles, only the most valuable and necessary articles were carried from place to place. No man could afford to sacrifice his very life by being prodigal with such commodities. In short, so long as men lived in an age of underproduction the greatest care was exercised to retain as long as possible what was produced.

But manufacturing by machines and transportation by railroads has changed all this; products are cheap and available at all times everywhere. Emphasis has shifted from production to distribution and consumption. Manufactured articles need not be treasured or carefully preserved nor even completely worn out because new articles are cheap enough to warrant the discarding the old. Living in an age of plenty rather than scarcity we have gone too far in our lavishness with the result that we are contemptuous of small savings and seldom make large ones. We are too literal in adopting the teaching of taking no thought for the morrow. Our resources are squandered recklessly, our property is not fully used and is carelessly exposed to unnecessary deterioration, our time is frittered away in unproductive restlessness, and even our energy has been dissipated without thought of reckoning. The poor have emulated the well-to-do so it is doubtful if our greater plenty of material things has resulted in larger individual happiness or marked improvement in wealth per capita. If manufacturing has aided in bringing about this situation it has not proved an unmixed blessing.

Stimulus to Other Industries

In addition to changing our place of residence from country to town and materially altering our racial purity or upsetting apparently fixed traits of character, manufacturing has been a direct stimulus to all other branches of industry. In touching upon this topic we are tampering with a delicate, complicated adjustment for no one industry stands alone but is a product of conditions in all others as well as exerting an influence upon all others. For instance, manufacturing in its present stage of development could not exist without the exploitation of our resources in farms, mines, and forests and particularly the extension and consolidation of the means of transportation or communication. Yet in turn none of these activities could have reached so great a degree of importance without the goad afforded by our growing manufacturing enterprises.

The variety, complexity, and volume of our agriculture probably could not be sustained if the great market for farm products in the mills were removed. The factories draw upon the farms for three-fourths of their raw materials, to say nothing of the great market provided for the consumption of farm products in factory communities. Without shops our farms and our country would doubtless resemble Argentina, a truly progressive nation but one retarded by the lack of diversified manufacturing within its own borders. Similarly our mines and our forests could hardly have been supported by foreign markets if the great domestic consumers of their products were not present.

Railroads

Lastly, and more imperatively than the foregoing our railroads have been peculiarly dependent upon our mills for their livelihood and expansion. To the factories, the roads have brought the materials collected from the farms, mines, forests, and ports; and from the shops the railroads have carried the finished commodities to the consumers in other manufacturing districts as well as to those engaged in agriculture, mining, or lumbering. If all the traffic a railroad could secure were that which arose from carrying raw materials to export points there would be fewer roads and these would have smaller incomes. For although imports of manufactured goods would of necessity travel inland to the raw material centers, the resource exploited would be on a smaller scale and there would be fewer people to supply. Especially would there be far less intercity freight movement because there would be fewer cities. The growth of manufacturing, therefore, has promoted the progress of all other industries and these in turn have enhanced the importance of manufacturing itself.

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